LABORERS-AGC

Education and Training Fund

Hazardous Waste Worker Refresher Manual

Hazardous Waste Worker Refresher

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HAZARDOUS WASTE WORKER REFRESHER

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HAZARD RECOGNITION

TRAINEE OBJECTIVES

After completing Section 1, you will be able to:

1. List the three general categories of hazards at a hazardous waste site.

2. Define the following terms and give one example of each.

   Corrosive
   Biological hazards
   Physical hazards
   Explosion
   Safety hazards

3. Identify the difference between flammable material and combustible material.

4. List the two major types of radiation.

5. List five safety hazards found on a hazardous waste site.

INTRODUCTION

Every hazardous waste worker has a responsibility to look for and recognize hazards. You should always stay alert to the possibility of hazards, regardless of the particular stage of activity underway at a waste site. The site characterization section of the site-specific Safety and Health Plan is the best source of information for the particular hazards during waste site activities.

Hazard Recognition Concepts

The Safety and Health Officer (S&HO), or other designated person at a waste site, uses a formal, scientific method of sampling and analyzing to determine possible hazards present on a site. This method is called site characterization. You will also use a method for determining hazards: the common sense method, which requires enhancing your powers of observation. You can spot potential hazards by the following actions:

- Look for areas of dead vegetation, dead animals, discolored water, or soil.

- Notice the condition of visible tanks, drums, or similar containers. For example, are they:

  - Bulging
  - Corroded
  - Deformed
  - Labeled
  - Leaking
  - Poorly stacked

- Pay attention to unusual smells.

- Look for safety hazards, such as:

  - Confined spaces
  - Overhead power lines
  - Pits
  - Slippery roads or work surfaces
  - Small buildings in bad condition
  - Steep slopes
  - Tanks
  - Trenches

However, the common sense approach has limitations. For example, you cannot assume a site is safe because there are no chemical smells. Many hazards cannot be detected without instruments. These include *radiation*, chemicals, many biological hazards, *shock-sensitive* materials, and other complex hazards.

Hazards at a Waste Site

A hazardous waste site contains a variety of hazards. They can be grouped into three general categories:

- Chemical
- Biological
- Physical

CHEMICAL HAZARDS

Chemical hazards are chemical compounds that produce toxic effects on the body when inhaled, ingested, or absorbed. They come in various forms and states, such as:

- Dusts
- Fumes
- Gases
- Liquids
- Mists
- Solids
- Vapors

Chemical hazards are classified as:

- *Toxic*
- *Corrosive*
- Oxygen deficient

Special care should be taken to protect yourself from chemical exposure. Employing all available and possible protective procedures helps to ensure a safe working environment for all site workers. Protective procedures include *engineering controls*, *administrative controls*, and *personnel protective equipment*. The specified personal protective measures must be carefully followed.

Toxic Chemicals

A toxic chemical is any substance that can cause, or is suspected to cause, injury to the human body (under certain conditions). Some toxic chemicals pose an immediate threat to your life or health. Other chemicals take years to cause sickness or death. The extent a chemical effect has on your body depends on:

- The toxicity of the chemical
- Chemical exposure time
- Chemical concentration

Corrosives

Corrosives are chemicals that cause visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. Common corrosive chemicals are acids, bases, and halogens such as chlorine and fluorine. Corrosives are of concern because of their ability to corrode materials such as metals. Some corrosives also attack skin, causing burns and dermatitis, as well as other skin disorders. The pH scale indicates corrosive strength, and ranges from 0-14 (Figure 1-1).

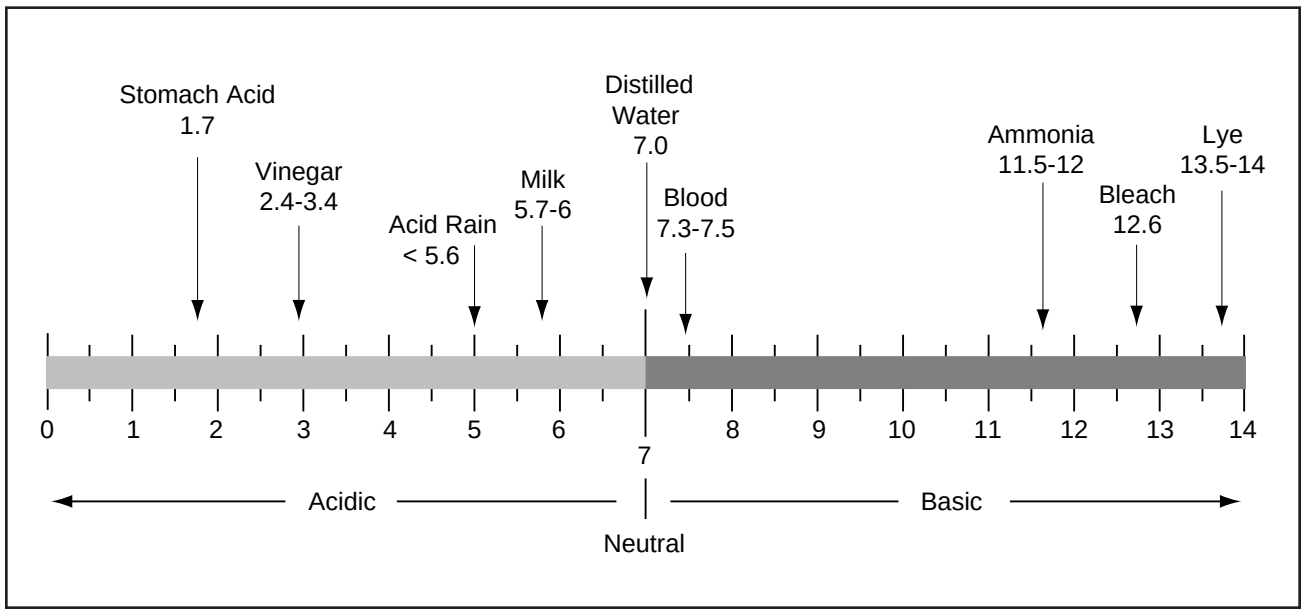

Figure 1-1. The pH scale ranges from 0 to 14. The strongest acid has a pH of 0, and the strongest base has a pH of 14.

Oxygen Deficiency

The oxygen content of normal breathing air is about 21 percent by volume. As defined by the Occupational Safety and Health Administration (*OSHA*), an oxygen-deficient atmosphere has an oxygen level below 19.5 percent by volume. Oxygen deficiency occurs when:

- A substance reacts with and uses up the oxygen.
- Other gases displace (push out) the breathable air (and oxygen).

Take special care when working in confined spaces or other areas where oxygen can be used up or displaced.

BIOLOGICAL HAZARDS

Biological hazards are infectious waste or related to the physical environment of the hazardous waste site.

Infectious or biological waste usually comes from hospitals and medical laboratories. It may or may not be labeled as biological waste, depending upon the time it was discarded. Take precautions when handling biological waste.

Animals and insects found on the site can carry infectious diseases such as rabies or Lyme disease. Unlike chemicals, biological hazards contain living organisms that use the body as a host.

Plants and wildlife also present their own natural hazards. Poison ivy, poison oak, and poison sumac can cause severe skin irritations. Depending upon the region of the country, you may have to watch out for poisonous reptiles and spiders, such as rattlesnakes, copperhead snakes, and scorpions.

Precautions for biological hazards are similar to those for chemicals—skin and respiratory protection are required. Take special care to ensure that cuts and scrapes are not exposed in any way.

Usually biological waste is separate from industrial hazardous waste. The exception is sewage treatment plant waste. This waste is packaged like industrial hazardous waste but is considered biological waste.

PHYSICAL HAZARDS

Physical hazards cause the largest number of accidents on a hazardous waste site. A physical hazard is any condition that produces harmful levels of:

- Electromagnetic radiation
- Light
- Noise
- Heat or cold
- Vibration

The following are also classified as physical hazards:

- *Combustible material*
- Compressed gas
- Explosive
- *Flammable material*
- Organic peroxide
- *Oxidizer*
- *Pyrophoric material*
- *Unstable material*
- *Water-reactive material*

Fire Hazards

Many materials on a waste site can be flammable or combustible. The difference between a flammable material and a combustible material is the *flash point*. A flammable material is usually a liquid that will burn at temperatures below 100°F (Fahrenheit) when exposed to a spark or ignition source. An example of a flammable substance is gasoline.

A combustible material can be either a solid or liquid. It will burn at temperatures above 100°F when exposed to an ignition source. Paper or fuel oil are examples of combustible materials.

Another factor that relates to flammability is the vapor concentration in air. The lower flammable limit (*LFL*) is the lowest concentration that can support combustion and the upper flammable limit (*UFL*) is the highest concentration of vapors that can support a fire. The concentration between the LFL and the UFL make up the *flammable range*.

Explosive Hazards

An explosion is the release of energy in a rapid and uncontrolled manner. Explosions can occur from different sources. Most often the source of energy is a *chemical reaction*. However, mechanical explosions can occur.

A chemical's explosive range is the same as its flammable range with one difference. The explosive range refers to materials ignited in an enclosed or confined space. The flammable range refers to materials ignited in an open area.

Some chemicals are unstable. They can explode if they are subjected to friction, heat, or shock. These types of chemicals are known as shock sensitive chemicals and should be handled carefully.

Note: Shock sensitive materials may not be labeled as explosive.

Radiation Hazards

Radiation is energy emitted (given off) from a material in the form of rays or particles. There are two major types of radiation: ionizing and nonionizing radiation.

Radiation hazards are tested for during the site characterization survey. Professionals, such as a radiation health physicist, radiation protection technician, or health physicist technician, determine and identify the type of radiation hazard that may be present.

Ionizing Radiation

Ionizing radiation damages the body by changing or destroying a cell's atomic structure. The radiological hazard, or damage to the body, depends on the type of radiation. Ionizing radiation can be both an external and internal hazard. Externally, radiation damages the skin and eyes. Internally, it damages organs, tissues, and cells within the body.

There are four types of ionizing radiation:

- Alpha particles
- Beta particles
- Gamma rays
- Neutron particles

Nonionizing Radiation

Nonionizing radiation is energy emitted from materials in the form of waves that do not have enough energy to change atoms. Although there are some health hazards associated with nonionizing radiation, it is not as dangerous as ionizing radiation.

Radioactive Materials are Chemicals

It is also important to realize that radioactive materials are chemicals with their own chemical hazards. For example, uranium hexofluoride, in addition to being radioactive, is also a heavy metal and an acid.

Reactive Hazards

Substances that have a tendency to participate in chemical reactions are called reactive materials. Reactive materials must be handled with care. The following examples show the hazards of reactive materials:

- A strong acid poured into a strong *base* (*caustic*) results in a vigorous and dangerous reaction.
- Sodium metal in water reacts violently.
- Oxidizers can release large amounts of oxygen when they react, causing other hazards like fire and explosion.

Chemical Reactions Defined

A chemical reaction occurs when two or more chemicals are mixed together, causing a chemical change and producing a new substance. In an industrial plant chemical reactions are controlled and result in the production of goods. Everyday products such as plastics, nylon, and aspirin come from chemical reactions.

However, chemical reactions are not always controlled on hazardous waste sites. For example, leaking containers can allow *incompatible* chemicals to mix, producing dangerous results. Uncontrolled chemical reactions can result in toxic vapors, explosions, and fires. Some reactions can produce new chemicals with additional hazards.

GENERAL SITE SAFETY

As a hazardous waste worker, you face a higher risk of accidents and injury than the typical industrial employee. You will often have to deal with situations with little information. Wearing personal protective equipment (*PPE*) to reduce chemical exposures can increase the possibility of accidents. In addition to the chemical, biological, and physical hazards you face on the hazardous waste site, you also have all of the typical construction site safety hazards.

Safety Hazards

A safety hazard is a state in which the risk of harm or injury (to a person) or damage exceeds an acceptable level. Any or all of the following safety hazards can be present on a hazardous waste site:

- Striking or struck by - slips, trips, hit by a vehicle
- Thermal - fires, hot pipes, explosions, and equipment
- Electrical - wiring, equipment, grounding, power lines
- Acoustical - noise from loud machinery or tools
- Falls

Safety Procedures

General site safety procedures include the use of engineering controls, safe work practices, and PPE. Employing all available and possible protective measures helps to ensure a safe working environment for site personnel. Many procedures and controls are common to all hazardous waste sites, while others are site-specific and are based on the unique hazards of a site. General site safety practices include the following:

- Read and understand the site safety and health plan.
- Do not eat, drink, chew, or smoke in any area designated as contaminated.
- Use good personal hygiene upon leaving the work area and before eating, drinking, or any other activities.
- Use PPE properly.

- Avoid contact with contaminated surfaces or with surfaces suspected of being contaminated. Whenever possible, you should not:
  - Walk through puddles, mud, or on other discolored surfaces.
  - Kneel on the ground.
  - Lean, sit, or place equipment on drums, containers, vehicles, or the ground.
- Consult your doctor about possible reactions between prescription medicines and exposures to toxic chemicals.
- Use proper decontamination procedures when leaving a contaminated area.
- Only the personnel necessary for effective site operations should be in a contaminated area.
- Work areas for specific work activities must be established.

SECTION 1 - ASSIGNMENT SHEET

1. List the three general categories of hazards at a waste site.

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2. Define the following terms and give one example of each.

Biological hazards _____

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Corrosive _____

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Physical hazards _____

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Safety hazards _____

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Explosion _____

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3. Identify the difference between a flammable material and a combustible material.

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4. List the two major types of radiation.

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5. List five safety hazards found on a hazardous waste site.

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2

HAZARDOUS WASTE WORKER REFRESHER

Section

2

Title

HAZARD COMMUNICATION

TRAINEE OBJECTIVES

After completing Section 2, you will be able to:

1. Define the following terms or words:
   Administrative controls
   Engineering controls
   Substitution

2. Identify the following acronyms:
   PEL
   TWA
   TLV
   STEL
   ACGIH

3. Give the basic employer and employee responsibilities under the Hazard Communication Standard.

4. List the items that must be in a written Hazard Communication Program.

5. List the basic information that must be covered in the employer's training program for hazard communication.

6. List the information the employer must provide each employee.

7. List the exposure control measures that protect you from exposure.

INTRODUCTION

Effective hazard communication requires the cooperation of employees and employers alike. It is the employer's responsibility to provide workers with specific information and training about hazardous chemicals in the work area. As the employee, you are responsible for using the information and training to recognize chemical hazards and to take steps to prevent exposure to those hazards.

HAZARD COMMUNICATION STANDARD

The Occupational Safety and Health Administration (*OSHA*) has implemented the Hazard Communication Standard for the construction industry (29 *CFR* 1926.59) and the general industry (29 CFR 1910.1200). The Standard specifically states:

> "The purpose of this section is to ensure that the hazards of all chemicals produced or imported are evaluated and that information concerning their hazards is transmitted to employers and employees."

The Standard requires manufacturers to inform employers of the hazards relating to their chemicals. In turn, employers must inform employees who use the chemicals or come in contact with them about the hazards.

Scope of the Standard

The Hazard Communication Standard applies to the following situations:

- To any chemical known to be present in the workplace where employees can be exposed during normal use.
- When chemical exposure can occur during a foreseeable emergency.

This standard does not apply to:

- Alcoholic beverages
- Articles (chairs, tables, etc.)
- Consumer products
- Food, drugs, and cosmetics
- *Hazardous waste*
- Tobacco or tobacco products
- Wood or wood products

Although the Hazard Communication Standard does not apply to hazardous waste, hazardous waste sites are work sites where chemicals are used during the work procedures. Therefore, personnel at hazardous waste sites must comply with the hazard communication regulation.

Hazard Determination

The Hazard Communication Standard further requires chemical manufacturers, importers, and employers to determine if the chemicals or substances they produce, import, or use in the workplace are hazardous. In most cases, hazard determinations are done by the chemical manufacturer before the chemical is used in the workplace. Once a substance is determined to be hazardous, it falls under the scope of this standard.

Written Hazard Communication Program

Under the Hazard Communication Standard, employers must develop, implement, and maintain a written Hazard Communication Program. It must be available at the workplace and upon request to employees, their representatives, and OSHA.

A company's written Hazard Communication Program must:

- List the hazardous chemicals on the job site.
- Explain the method the contractor will use to inform employees of hazards associated with nonroutine tasks involving hazardous chemicals.
- Explain the labels and other forms of warning to be used by the employer.
- Explain how employees will be provided with *material safety data sheets* (*MSDS*s).
- Describe employer training to teach employees about hazardous chemicals.

Multiple Employer Sites

To ensure that employees will not be exposed to chemical hazards from other employers at the same site, the regulations require that all employers on a multiple employer site provide information to each other.

Along with the information previously mentioned, the written Hazard Communication Program of a multiple employer site must also explain:

- How one employer will provide the other employer(s) with a copy of the MSDS, or make it available at a central location in the workplace, for each hazardous chemical the other employer's employees can be exposed to while working.

- The methods the employer will use to inform the other employer(s) of any precautionary measures that need to be taken to protect employees during the normal workplace operating conditions and in foreseeable emergencies.

- The methods the employer will use to inform the other employer(s) of the labeling system.

Information and Training

The Hazard Communication Standard also requires employers to provide specific information and training so employees know:

- How to recognize the hazardous chemicals on the job site.

- The safety and health effects of the hazardous chemicals on the job site.

- How to protect themselves from the hazardous chemicals.

An employer's training program must at least cover the following hazard communication information:

- Requirements of the OSHA Hazard Communication Standard.

- Operations in the work area where hazardous chemicals are present.

- Location and availability of the:
  - List of hazardous chemicals.
  - MSDSs for all hazardous chemicals used on the site.
  - Written Hazard Communication Program.

Employers must also provide, or ensure that employees have been provided, all of the following information:

- Methods and observations used to detect the presence or release of hazardous chemicals in the work area, including:
  - Labels
  - Color
  - Form (solid, liquid, gas)
  - Odor
- The physical and health hazards that employee can be exposed to from the hazardous chemicals on the job.
- The work practices, protective equipment, and emergency procedures employees can use to protect themselves.
- Details of the Hazard Communication Program used by the employer, including labels, lists, MSDSs, and how employees can get and use hazard information.

EXPOSURE GUIDES

When working around hazardous chemicals, exposure is an important consideration. Exposure guides are used to inform you about warnings and exposure limits and to make decisions about worker exposure to chemicals.

General Exposure Guides

Some exposure guides are general. They give instructions or information about a chemical using a short phrase, word, numbers, or symbols. These general guides are usually found on labels or placards on

chemical containers. However, the chemical identity does not need to be known in order for general guidelines to be useful.

Specific Exposure Guides

When the the employer knows both the identity of a chemical and its air concentration at the work site, more specific exposure guides can be applied. *Permissible exposure limits*, threshold limit values, and recommended exposure limits are three commonly used exposure guides that deal with concentration levels.

Permissible exposure limits (*PELs*) are the only legally enforceable limits because they are set by OSHA. This means that by law, your employer must keep your exposure below the PEL. PELs are meant to offer the minimum levels of protection. However, more protective limits are always allowed.

Threshold limit values (*TLVs*) are set by the American Conference of Governmental Industrial Hygienists (*ACGIH*). They are based on the best available information from industrial experience, experimental human studies, and animal studies. The basis on which the values are established can differ from chemical to chemical. TLVs are only advisory and are not legally enforceable. A revised list of TLVs is published each year, which makes them more current than PELs. However, chronic effects are not always given enough consideration in setting TLVs.

Recommended exposure limits (*RELs*) are set by the National Institute of Occupational Safety and Health (NIOSH). Unlike PELs and TLVs, RELs are based on a TWA concentration for up to a 10-hour workday during a 40-hour work week.

Presenting Exposure Limits

There are three ways to present exposure limits.

1. *Time weighted average* (*TWA*) - The average concentration of a substance in an area over an 8-hour work shift of a 40-hour work week. The changes in exposures that occur during the work shift are averaged out.

2. *Short term exposure limit* (*STEL*) - The maximum concentration of a substance that you can be exposed to for a short period of time (usually 10 to 15 minutes). Above the STEL, you can experience the following health effects:

   - Chronic irreversible tissue damage.

   - Dizziness sufficient to increase the risk of accidents, impair self-rescue, or reduce work efficiency.

   - Irritation.

   An exposure above the STEL shall not occur more than four times per shift, and there shall be at least 60 minutes between exposures. The daily TWA PEL must **not** be exceeded.

3. *Ceiling limit* is an exposure that shall **never** be exceeded at any time.

The MSDS for a chemical must list chemical exposure limits. The limits can also appear on the product container label.

Skin Notation

The notation “skin” used in OSHA PEL lists and the ACGIH TLV publication indicates that the chemical can be absorbed through the skin. Therefore, take steps to avoid skin contact with these chemicals. Even when the PEL, TLV, or REL is within the standard, you can suffer adverse health effects from a chemical due to skin absorption.

Exposure Control Measures

Exposure control measures were developed to protect you from chemical exposure and include:

- *Substitution*
- *Engineering controls*
- *Administrative controls*
- *Personal protective equipment* (*PPE*)

Substitution is the most desirable control measure because it eliminates the original hazard.

Engineering controls reduce or eliminate exposures by using mechanical means. It does not eliminate the hazard.

Administrative controls reduce exposures to an acceptable limit by removing the worker from the exposure after a specific length of time or by establishing work rules.

PPE is the least desirable exposure control measure because the hazard is still present so exposure is possible.

SECTION 2 - ASSIGNMENT SHEET

1. Define the following terms or words:

   Administrative controls _____

   _____

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   _____

   Engineering controls _____

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   _____

   _____

   Substitution _____

   _____

   _____

   _____

2. Identify the following acronyms:

   PEL _____

   TWA _____

   TLV_____

   STEL _____

   ACGIH _____

3. Give the basic employer and worker responsibilities under the Hazard Communication Standard.

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4. List the items that must be in a written Hazard Communication Program.

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5. List the basic information that must be covered in the employer's training program for hazard communication.

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6. List the information the employer must provide each employee.

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7. List the exposure control measures that protect workers from exposure.

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HAZARDOUS WASTE WORKER REFRESHER

Section

3

Title

HEALTH EFFECTS

TRAINEE OBJECTIVES

After completing Section 3, you will be able to:

1. List the four routes of exposure.
2. Write the definition of dose.
3. List four forms of heat stress and give the symptoms of each.
4. List actions an employer should take to prevent heat stress in an employee.
5. List actions to take to prevent heat stress.
6. Give three limitations of medical testing.
7. List seven common medical tests and procedures that may be given before working on a hazardous waste site.

CHEMICAL EFFECTS ON THE BODY

The body is a complex collection of cells, tissues, and organs working together. When threatened by disease, trauma, or foreign substances, the body defends itself through its immune system. Exposure to toxic chemicals may break down this defense system resulting in injury, illness, or death.

Routes of Entry

Substances enter the body through four routes of entry:

- Absorption through the skin
- *Ingestion* (swallowing)
- *Inhalation* (breathing)
- Injection (hypodermic or break in the skin)

Dose

The *dose* you receive of a toxic substance determines the effect the substance will have on your body. Dose is defined by the amount or concentration of a substance received. It is one the most important factors in determining if you will have an adverse health effect from a chemical exposure.

Toxic substances affect individuals differently. For example, not everyone will suffer health effects at the same dose, nor will the effects have the same degree of severity for all workers.

While the dose of one chemical can be too low to affect you, the interaction of different chemicals at low doses can be harmful.

Interactions

An *interaction* occurs when exposure to more than one substance results in a health effect different from the effects of either one alone. There are two types of interactions—synergism and potentiation.

Synergism is a process whereby two chemicals produce an effect that is greater than both of their effects together. For example, smoking one pack of cigarettes per day **or** being heavily exposed to asbestos may increase the risk of lung cancer 6 to 10 times that of a person who has had neither exposure. However, smoking cigarettes **and** being exposed to asbestos, increases the risk of lung cancer 50 to 90 times that of a person who has had neither exposure.

Potentiation occurs when an effect of one substance is increased by exposure to a second substance which would not cause that effect by itself. For example, acetone does not damage the liver by itself. But acetone can increase the ability of carbon tetrachloride to damage the liver.

Latency Period

The period between the first exposure to a toxic substance and the development of disease is called the *latency period*.

Local and Systemic Effects

An injury that occurs at the point where a toxic substance touches or enters the body is called a *local effect*. For example, a skin rash caused by touching poison ivy would be a local effect. A *systemic effect* develops at some place other than the point of contact. For example, kidney damage caused by a substance inhaled through the lungs would be a systemic effect.

SUBSTANCES THAT AFFECT THE BODY

Hazardous chemicals can come in various forms, including dusts, gases, fumes, mists, and vapors.

Dusts

Dusts are small particles suspended in air. Microscopic dusts are too small to be seen with the naked eye. However, they do the most damage because they travel deeper into the lungs during inhalation. These dusts are known as respirable, or breathable, dusts and may build up in the lungs. This will reduce your ability to breath. Others, such as cement and arsenic, can also directly affect the skin.

Gases

A gas is a state of matter that is formless at room temperature and expands to fill its container. (States of matter are gases, liquids, and solids.) Toxic gases can directly irritate the skin, throat, eyes, and lungs. They may also pass from the lungs into the blood stream. Once in the blood stream, gases can travel to other parts of the body and damage organs or tissues. In addition, some gases can decrease the blood's ability to carry oxygen.

Fumes

Fumes are solid particles in the air that are generated when metals are heated. They are small enough to be inhaled and able to reach the deepest parts of the lungs. Because of their small size, many of them get past the

body's natural defenses. Once in the lungs, fumes can be picked up by the blood and carried to other parts of the body, thus affecting other organs.

Mists

Mists are small liquid droplets suspended in air. Many types of mists damage the body by coming into direct contact with skin and eyes and by being inhaled. They move easily into the blood stream and then to other parts of the body.

Vapors

Vapors are gaseous forms of materials that are usually solid or liquid at room temperature. Solvent vapors are one of the most common exposures at a hazardous waste site. Vapors can affect the skin and cause *dermatitis*. They can also be inhaled into the lungs or absorbed through the skin. Both routes allow vapors to pass into the blood stream.

PROMPT EFFECTS

Prompt health effects occur quickly, usually after exposures to high concentrations of a hazardous material. Most prompt effects are temporary and disappear shortly after the exposure is removed. However, permanent damage may occur if exposures are high enough.

Chemicals can produce prompt effects in various parts of the body. Examples include:

- Nervous system
- Kidneys
- Lungs
- Skin

Nervous System

When inhaled, solvent vapors enter the blood stream and can produce a narcotic-like effect on the nervous system. Symptoms of this effect, such as poor coordination, can contribute to falls and other accidents.

Carbon monoxide, an odorless gas, affects the brain and heart by robbing the body of its oxygen supply. After being inhaled, carbon monoxide combines readily with hemoglobin, the blood's oxygen carrier. This binding prevents oxygen from being picked up by the hemoglobin and transported throughout the body. Exposure to high levels of carbon monoxide prevents the body from getting enough oxygen and can result in death.

Kidneys

Kidney damage can occur after exposure to solvents and heavy metals, such as lead, nickel, and cadmium. Severe damage may cause kidney failure. Symptoms of kidney damage are:

- Fatigue
- Lower back pain
- Blood in the urine

Lungs

Chemicals affect the lungs in several ways. Some chemicals irritate the lungs while others cause sensitization. Sensitization usually occurs after repeated exposures, and the lungs build up an immune response to a substance. High chemical levels can burn and blister the lungs, resulting in *pulmonary edema*. Pulmonary edema is fluid buildup in the lungs causing shortness of breath, and if severe enough, death.

Skin

Chemicals that get on the skin can cause rashes, ulcers, blisters, and other skin disorders. Effects can occur immediately or within hours or days after exposures. Most of the solvents cause some form of dermatitis, such as:

- Blisters
- Cracking
- Redness
- Skin dryness

DELAYED EFFECTS

Delayed health effects take a long time to develop. They may be caused by exposures to fairly low levels of chemicals or chemical concentrations over a period of time, sometimes even years, or after an acute exposure to a chemical.

CHRONIC DISEASES

A chronic disease is a disease that once contracted tends to last a long period of time. Many chronic diseases have no cure—treatment focuses on keeping the disease from getting worse. Therefore, prevention is important.

Chronic diseases can affect every part of the body. Specific examples discussed in this section are:

- Cancer and the body
- Lungs
- Liver
- Brain
- Kidneys

Cancer and the Body

Cancer defines a group of diseases in which the body's cells reproduce without control. This uncontrolled growth produces masses of cells called tumors. The cause of cancer is unknown. However, environmental exposures and hereditary and biological factors play important roles in the development of cancer.

Any substance that causes cancer is called a *carcinogen*. Radiation, arsenic, asbestos, and benzene are examples of carcinogens. There is no safe exposure level for carcinogens. Permissible exposure limits (*PEL*s) are established at levels that reduce the probability of cancer from certain chemicals. You should keep your exposure to any chemical suspected of causing cancer as low as reasonably achievable. This is true even if the exposure is below the current, acceptable standards.

Lungs

Chronic lung disease is one of the top ten causes of death in the United States. No matter what the cause, a chronic lung disease will make you feel short of breath and limit your activity. Chronic lung diseases include a range of lung disorders:

- Asbestosis
- Asthma
- Chronic bronchitis
- Chronic emphysema
- Silicosis

These diseases result in persistent obstructions in the airway passages of the lungs that reduce airflow. Symptoms include:

- Coughing
- Shortness of breath
- Weakness

Liver

Cirrhosis is a chronic liver disease that scars the liver and reduces its ability to function normally. Symptoms include:

- Chronic fatigue (tired all the time)
- Muscle atrophy (muscle wastes away)
- Stomach swelling due to fluid accumulation

Many chemicals can cause cirrhosis of the liver, such as carbon tetrachloride, chloroform, and alcohol. Biological agents also may damage the liver.

Brain

The brain is affected by chronic exposure. Laborers exposed to solvents, such as toluene or xylene in oil-based paints, may find that their brain is affected over time. Symptoms include:

- Memory loss
- Increased irritability
- Lowered IQ

Kidneys

Chronic kidney disease is a common condition. Heavy metals, such as lead and mercury, as well as solvents are suspected of causing chronic kidney disease. Symptoms include:

- Chronic fatigue
- High blood pressure
- Swelling of the feet

PHYSICAL WARNING SIGNS

Physical warning signs are indications that you may have been exposed to toxic chemicals. If any of these signs occur, leave the area and report the problem to the supervisor immediately. Do **not** return to the area until the cause of the symptoms has been checked by a qualified person.

The six physical warning signs of chemical exposure are:

1. Breathing difficulties – breathing faster or deeper, soreness, a lump in the throat
2. Dizziness, drowsiness, disorientation, difficulty concentrating
3. Burning sensation in the eyes or on the skin
4. Weakness, fatigue, lack of energy
5. Chills, upset stomach
6. Odors and/or a strange taste in the mouth

REPRODUCTIVE HAZARDS

Exposure to some chemicals can affect the reproductive health of a man or woman. Infertility, birth defects, and problems related to pregnancy can result from chemical exposures. For example:

- Women - Unable to become pregnant or may have frequent early miscarriages.
- Men - Sperm production can be abnormal, reduced, or stopped entirely.

Exposure to some chemicals can cause *mutagenic effects* in both men and women. A mutagenic effect is a permanent change (mutation) to the genes or chromosomes in the ovum (egg) or sperm. The mutated gene(s) can be passed on to offspring and result in birth defects.

A birth defect can also be a *teratogenic effec*t. A teratogenic effect occurs when the mother is directly exposed to a chemical during pregnancy. The chemical exposure affects the developing embryo causing damage.

ERGONOMIC HAZARDS

Ergonomic principles involve the way that you interact with your workplace. The human body can endure considerable discomfort and stress. It can also perform many awkward and unnatural movements for a limited time. However, continuing these movements for long periods of time may exceed the physical limitations of the body.

Lifting Injuries

Lifting is so much a part of many everyday jobs that most people do not think about it. But lifting is often done incorrectly, with unfortunate results such as pulled muscles or back injuries.

Proper lifting techniques, good nutritional habits, muscle tone, weight management, stress management, and avoiding the use of tobacco products help prevent back injuries.

Cumulative Trauma

Cumulative trauma disorders (*CTD)* occur when job demands exceed the body's physical abilities. They are also referred to as repetitive motion disorders. Vibration also contributes to the development of CTD. Workers who use chain saws, pneumatic tools, and vibrating electric tools throughout the work shift are at risk. Symptoms of vibration-induced health problems affecting the fingers include:

- Numbness
- Pain
- Whiteness of the fingers
- Loss of finger movement and coordination

TEMPERATURE EXTREMES

Extreme temperature conditions can affect your health as well as your ability to safely perform your tasks. Knowing the signs and symptoms of heat stress and cold stress can help you prevent injury.

Heat Stress

Heat stress is a major physical hazard on a hazardous waste site and can occur without warning. The chance of developing heat stress increases with increased humidity, hot environments, and the use of PPE. Regular monitoring and knowing the signs and symptoms of heat stress are essential precautions (Table 3-1).

TABLE 3-1

SIGNS AND SYMPTOMS OF HEAT STRESS

Types of Heat Stress	Cause	Signs/Symptoms
Heat rash	Heavy sweating when sweat is not easily removed by skin evaporation.	Redness on skin Blisters or a rash
Heat cramps	Heavy sweating with inadequate electrolyte replacement.	Muscle spasms Pain in hands, feet, and abdomen
Heat exhaustion	Increased stress on various body organs and the circulation system. Caused by the inability of the the heart to work properly and/or dehydration.	Dizziness Nausea Normal to low temperature Heavy sweating Pale, cool, moist skin Rapid pulse and breathing Fainting
Heat stroke	Heat stroke is the most serious form of heat stress. Temperature regulation fails. Body temperature rises to critical levels, as high as 108° to 112°F. The body must be cooled immediately before serious injury or death occurs. Competent medical help must be obtained.	Dizziness, confusion Nausea High fever Little or no sweating Red, hot, usually dry skin Strong, rapid pulse Convulsions Coma Death

In a hot environment, the body maintains a normal temperature by:

- Sweating, which carries away heat.

- Sending more blood to the skin. Blood carries heat to the skin, where the heat is lost to the surrounding air. Sweating is your body's most effective way to get rid of excess heat, as long as you drink enough fluids to replace the sweat. The body stops sweating when it is severely stressed by heat. This is when the most severe consequences of heat stress occur.

Because the body cools down by sending blood to the skin, less blood is available to circulate to the brain and muscles. Because the blood carries oxygen, reduced blood circulation means a reduction in oxygen as well. Low oxygen levels produce a tired feeling and a decrease in mental alertness. Both factors can contribute to increased accidents in hot environments.

A decrease in mental abilities may also prevent the mind from understanding the signals or symptoms the body is experiencing. The person experiencing heat stress may be the last one to recognize the onset of a heat stress problem. Therefore, it is extremely important for you to be aware of any signs of heat stress in your fellow workers. This is the main reason why workers on hazardous waste sites work with buddies.

It is also important for you to maintain an awareness of your own body. Leave the work area at the first sign of change in your body or bodily functions.

Adequate rest periods, availability of large amounts of fluids, and frequent monitoring are essential in preventing heat stress.

Your Risk of Heat Stress

You may be at risk of heat stress if you are:

- Wearing protective clothing.

- Dehydrated from diarrhea or fever caused by infections.

- Physically unfit or have not worked in a hot environment in the preceding week (not acclimated).
- Afflicted with chronic disease, such as heart disease or diabetes.
- Dehydrated from drinking alcohol excessively or using drugs.
- Overweight.
- Regularly taking certain medications for depression, nervous conditions, high blood pressure, diabetes, or heart disease.

Actions Employers Should Take to Prevent Heat Stress

Employers can help prevent heat stress by taking the following actions:

- Schedule adequate rest periods.
- Provide shaded, and if possible, air-conditioned rest areas.
- Provide cool fluids to drink.
- Provide medical screening, including vital signs.
- Restrict activities.
- Provide adequate first-aid facilities for treatment of heat stress illness.

Steps You Can Take to Prevent Heat Stress

You can prevent heat stress if you follow these steps:

- Drink 1.5 gallons (4-6 liters) of fluids (water or juices) during the day, even when not thirsty. Alcohol, coffee, soda, and tea are not good fluids to replace water loss.
- Maintain good physical fitness. Work cautiously until you have become acclimated to the heat (adjusted to the heat).
- Recognize the signs and symptoms of heat stress.
- Monitor pulse, temperature, and weight.
- Check with a doctor if you have chronic health problems or are taking medication.

Monitoring for Heat Stress

You can reduce your risk of heat stress by regularly monitoring your pulse, temperature, and weight.

- Check your pulse (heart rate) during rest breaks. If it is faster than 120 beats per minute, work time should be reduced and rest time increased.
- Check your temperature at the end of the work period and before drinking fluids. If it is higher than 99.6°F (37.6°C), work time needs to be reduced and rest time increased. If it is higher than 100.6°F (38.1°C), PPE needs to be removed.
- Check your weight before and at the end of the work period. If weight loss is greater than 1.5 percent of your total body weight, drink more fluids during work.

Actions to Take if Heat Stress Occurs

Take the following actions to help a heat stress victim:

- Take victim to a cooler, uncontaminated area.
- Remove protective clothing.
- Give victim water to drink (**only** if conscious).
- Cool the victim with water, cold compresses, and/or rapid fanning.
- Call for emergency response and transport the victim to a medical facility for further cooling.
- Monitor pulse and temperature.

Cold Stress

When environmental temperatures drop, the body maintains its temperature by reducing blood flow to the skin. Reducing the blood flow to the skin decreases the amount of heat lost through the skin. However, it also causes a marked decrease in skin temperature. The most extreme effect is on extremities (e.g. fingers, toes, ear lobes, nose).

Harmful effects of cold stress include:

- Frostbite - Freezing of a body part, particularly the fingers, toes, ear lobes, and nose.
- Immersion Foot - Injury to the skin after prolong exposure to cold combined with dampness or water. No freezing occurs.
- Hypothermia - The body temperature drops because the body is unable to maintain its normal temperature. Signs and symptoms of hypothermia include:
  - Sleepiness
  - Irregular heartbeat
  - Hallucinations
  - Unconsciousness
  - Death

Your Risk of Cold Stress

You may be at risk of cold stress if you are:

- Wet from sweating or contact with water.
- Doing heavy labor and become fatigued.
- Taking sedatives or drinking alcohol before or during work.
- Inflicted with chronic diseases that affect the heart or blood vessels of the hands or feet.
- Physically unfit or have not worked in a cold environment recently.
- Using pavement breakers or other vibrating equipment.
- Performing tasks in high humidity and/or high winds.
- Inadequately dressed.
- In contact with metal and/or wet surfaces.

Steps You can Take to Prevent Cold Stress

You can prevent cold stress if you follow these steps:

- Wear several layers of loose fitting dry clothes that can be adjusted to match changing temperatures. A top layer of wind-proof clothing is useful in the wind.
- Cover your head. The body can lose up to 40 percent of its heat when the head is uncovered.
- Do not become overheated and sweaty.
- Keep extremities warm and check for numbness.
- Go to a warm shelter if you develop chills, sleepiness, or pain and cold in the extremities.
- Do **not** use sedatives or drink alcohol excessively. See a doctor if there are any questions.
- Do **not** work in cold weather if you have chronic heart or blood vessel disease.

MEDICAL MONITORING

Medical monitoring helps to determine your physical condition and whether any chemical exposures have occurred. You may see a doctor for any one of several reasons. Similarly a doctor may order medical tests for several different reasons.

Common Medical Tests and Procedures

Although a physician will decide what specific tests you need, the following tests and procedures are commonly performed:

- Questionnaire
- Physical examination
- Laboratory tests
- Pulmonary function test
- Electrocardiogram
- Chest x-ray
- Hearing test

Questionnaire

The questionnaire provides the doctor with your medical and work history. This history records any chronic diseases you may have had, such as lung, heart, kidney, or liver disease. It also records any symptoms indicating

heart or lung disease not previously diagnosed. Sometimes doctors are able to make a diagnosis from the history alone and then confirm the diagnosis with laboratory tests.

Physical Examination

A physical examination is beneficial for routine screening of existing medical conditions that may affect your ability to work on a hazardous waste site. From the examination, the doctor may decide laboratory tests are necessary.

Laboratory Tests

Laboratory tests are performed on blood and urine samples.

Urine tests check for:

- Diabetes
- Kidney function
- Presence of hazardous chemicals

Blood tests check for:

- Increased sugar, cholesterol, or fat levels in the blood
- Kidney function
- Liver function
- Presence of hazardous chemicals
- Red blood cell production and anemia (low levels of red blood cells)

Pulmonary Function Test

A pulmonary function test (*PFT*) helps to diagnose chronic lung diseases. It measures:

- The ability of the lungs to inhale and exhale
- Oxygen and carbon dioxide exchange
- Blood flow to the lungs

A PFT is also used to determine your ability to wear a respirator.

Electrocardiogram

An electrocardiogram (*ECG* or *EKG*) is used to check for the presence or evidence of a heart attack or an irregular heart beat.

Chest X-Ray

A chest x-ray helps to determine the cause of respiratory (breathing) problems. The doctor will decide if your history warrants a chest x-ray.

Hearing Test

A hearing test is used to check for any hearing loss caused by occupational noises. It also may indicate whether or not hearing protection has been used improperly or not at all.

Limitations of Medical Testing

No matter what tests are performed, it is important to understand that medical testing has limitations.

- Medical testing cannot prevent cancer. Cancer from exposure to chemicals or asbestos can only be prevented by reducing or eliminating an exposure.
- For many conditions, there is no medical test for early diagnosis. For example:
  - Routine blood tests for kidney function do not show abnormal results until 50 percent of kidney function has been lost.
  - Chest x-rays do not show lung cancer early enough to save most people. For this reason 9 out of 10 people with lung cancer die within five years.
- Medical tests are **not** perfect. Some tests can show false results, such as a false normal or a false abnormal.

OSHA MEDICAL SURVEILLANCE REQUIREMENTS

The following questions and answers cover the most important Occupational Safety and Health Administration (OSHA) medical surveillance requirements.

1. Who is covered?
   - Employees who may be exposed to hazardous substances at or above the PELs for 30 days or more per year.
   - Employees exposed above the PELs in an emergency situation.

2. How frequent are the exams?

    - Prior to assignment, annually thereafter, and at termination of assignment.

    - More frequent if a physician feels it is necessary.

    - Whenever an employee develops signs or symptoms indicating a possible exposure to hazardous substances.

3. What will the exams include?

    - Medical exam, questionnaire, and work history with special emphasis on symptoms related to hazardous substances and fitness to work wearing protective equipment during hot weather.

    - Anything else the physician determines is appropriate.

4. Who pays for the examination?

    - The employer pays for the exam. The exam must be conducted at a reasonable time and place without loss of pay to the employee.

5. Who gets the results of the exam?

    - Both the employer and employee are informed of the physician's opinion of the employee's ability to work while wearing a respirator and other PPE.

    - The employer is entitled to a written opinion limited to those medical conditions relating to work and/or occupational diagnosis. No specific findings or diagnoses unrelated to occupational exposure can be given to the employer by the physician.

DRUG TESTING

Today, the construction industry, as well as most other industries, require workers with more than just strong backs. More and more, Laborers and other workers must use intelligence and skills to work more safely and efficiently. Also, today's worker must be physically and mentally fit for duty. The majority of companies have drug-free workplace policies and may have to comply with federal regulations. Fit for duty on most job sites means being drug and alcohol free. This includes sites owned or controlled by the Department of Energy (DOE).

As an organization, LIUNA has a firm commitment to work site safety and improving the health of members and their families. One aspect of this commitment is educating members, union representatives, signatory contractors, and others on the health dangers and consequences of substance abuse.

Testing in the Workplace

Today, over 50 percent of workers nationwide are subject to drug and/or alcohol testing at the work site. In 1994, an estimated 87 percent of the major US companies conducted some form of pre-employment and/or employee testing. This number continues to climb each year. For LIUNA members, testing is often required by signatory contractors, government agencies, or owners as a condition of working on certain job sites.

WHERE TO GO FOR HELP

Providing assistance to members with substance abuse problems, and the often resulting personal problems, is the preferred alternative to the test and terminate approach practiced in some workplaces. Helping members by developing and publicizing sources of assistance is a win-win proposition for members, union officials, and employers.

The following resources are available to LIUNA members and their families for help in dealing with substance abuse problems:

- **Laborers' Membership Assistance Program (*MAP*)** – The Laborers' Health & Safety Fund of North America is available to provide information and consult with and assist health and welfare funds in establishing these programs. Member Assistance Programs are union-funded, typically linked to health

benefits, and provide the critical link between members, health care benefits for substance abuse, and a successful treatment experience.

- **Employee Assistance Programs (*EAP*s)** – Many employers offer this benefit to employees, often in conjunction with behavioral and mental health benefits. These programs are confidential and knowledgeable on issues of substance abuse and chemical dependency treatment. Contact the employer's human resources staff for details.

- **Community resources** – Each of the 50 states has designated two local AFL-CIO Community Services representatives to assist union members and representatives with substance abuse and a host of other personal and family issues. These individuals are knowledgeable and can provide referrals to local social service and United Way agencies.

- **Health benefits** – Many health plans, union or employer provided, include benefits for substance abuse and chemical dependency. Members should familiarize themselves with the plan eligibility rules and treatment coverage in order to make the best choice for assistance.

- **Self-help groups** – Free community resources include Alcoholic Anonymous, Al-Anon, 12 step, and related support groups. Most are listed in telephone directories.

SECTION 3 - ASSIGNMENT SHEET

1. List the four routes of exposure.

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2. Write the definition of dose.

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3. List four forms of heat stress and give the symptoms of each.

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4. List actions an employer should take to prevent heat stress in an employee.

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5. List actions to take to prevent heat stress.

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6. Give three limitations of medical testing.

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7. List seven common medical tests and procedures that may be given before working on a hazardous waste site.

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HAZARDOUS WASTE WORKER REFRESHER

Section

4

Title

PERSONAL PROTECTIVE EQUIPMENT

TRAINEE OBJECTIVES

After completing Section 4, you will be able to:

1. Define the following terms:

Degradation	Protection factor
Maximum use concentration	Qualitative fit test
Permeation	Quantitative fit test
Penetration	

2. Write out the following abbreviations or acronyms.

APR	PAPR
CPC	PPE
MUC	SCBA

3 List the five types of respirators and their protection factors.

4. List the limitations of negative pressure air purifying respirators.

5. List the limitations of the full-face supplied air respirator.

6. List the limitations of a self-contained breathing apparatus.

7. List the PPE used in Level A.

8. List the PPE used in Level B.

9. List the PPE used in Level C.

10. List the PPE used in Level D.

INTRODUCTION

Personal protective equipment (*PPE*) is any protective clothing or device worn to prevent contact with, and exposure to, hazards in the work place.

PPE is critical to the safe performance of hazardous waste work. Therefore, workers need an appreciation of the types of PPE, their limitations, and what goes into the selection process. The PPE issue is made more complicated because no one type protects against all chemical exposure situations. As a result, there are many types of protective gear. Choosing the correct type requires that the industrial hygienist have a detailed knowledge of the chemical exposure(s) at hand. This section discusses the following areas of PPE:

- Respirators
- Protective clothing
- Protective ensembles

RESPIRATORY PROTECTION

A respirator is a piece of equipment that reduces chemical exposures by preventing contaminants from being inhaled. Respirators are composed of a facepiece that seals out contaminants, and a device that provides clean air. Two types of respirators are used for obtaining clean air:

1. Air purifying – Filters are used to purify the air
2. Atmosphere supplying – A supply of clean air is provided from a tank or hose

Respirators differ in how much protection they afford Each respirator is given a score based on the amount of protection it can provide. This score is known as a *protection factor* (*PF*).

Protection Factors

The key to understanding respirator protection is to realize that all respirators leak to a certain degree. The amount of leakage depends on how well the facepiece seals to the face. A leak in the facepiece means that contaminated air can enter the facepiece. These leaks compromise the protection given by the respirator.

Respirators are tested for leakage by measuring the contaminant levels both outside and inside the respirator. Using the ratio of these two measurements, a PF is assigned. Respirator PFs range from 5 to 10,000.

Figure 4-1 shows the calculation for determining the PF.

The PF is calculated by dividing:

$$PF = \frac{\text{Concentration of airborne contaminant outside respirator}}{\text{Concentration inside the respirator}}$$

$$= \frac{500 \text{ ppm}}{50 \text{ ppm}} \quad \begin{matrix}\text{(concentration outside the respirator)} \\ \text{(concentration inside the respirator)}\end{matrix}$$

$$= 10$$

Figure 4-1. Calculating the protection factor.

The goal of a respirator is to reduce the amount of hazardous chemical inside the mask to below the Occupational Safety and Health Administration (*OSHA*) permissible exposure limit (*PEL*).

Maximum Use Concentration

Maximum use concentration (*MUC*) is that level of contaminants which, if exceeded, will cause a worker to be exposed above the PEL because of leakage into the respirator.

The MUC is calculated by multiplying PF times PEL. Figure 4-2 gives an example of calculating the MUC for nitric acid.

Calculate the MUC of nitric acid:

MUC = PF x PEL
PEL for nitric acid = 2 ppm
PF of half-face respirator = 10

MUC = 2 ppm x 10
= 20 ppm

A half-face respirator cannot be used in atmospheres with a nitric acid concentration greater than 20 ppm.

Figure 4-2. Calculating the MUC for nitric acid.

Table 4-1 lists general MUCs for chemical cartridges that have hazardous breakthrough problems.

Table 4-1. MUCs for cartridges with hazardous breakthrough.

Type of Cartridge	MUC
Organic vapors	1,000 ppm
Acid gases	1,000 ppm
Sulfur dioxide	50 ppm
Chlorine	10 ppm
Hydrochloric acid	50 ppm
Ammonia	300 ppm
Methylamine	100 ppm

AIR PURIFYING RESPIRATORS

Air purifying respirators (*APRs*) clean the air a worker breathes by removing or filtering a contaminant from the air before it enters the wearer's lungs. APRs have two components—the facepiece and the filter or cartridge.

Negative Pressure Respirators

APRs are usually called negative pressure respirators and are common at hazardous waste sites. They depend on lung power to pull the air through the filters and come in several different types (Table 4-2). Limitations for the negative pressure APRs are listed in Table 4-3.

Remember: Only use negative pressure APRs when oxygen levels are above 19.5%.

Table 4-2. Types of negative pressure APRs.

Type	Protection Factor	Notes for Hazardous Waste Sites
Single use (disposable)	5	Do not use.
Quarter face	5	Do not use. Covers only mouth and nose, rests on the chin.
Half face	10	Not often used on sites. No eye protection.
Full face	50	Often used on sites.

TABLE 4-3. Limitations of negative pressure APRs

Limitation	Notes
Eye irritation present	Can only use full-facepiece respirator.
Cartridge life: filters	Filter cartridge life depends upon the amount of material that is filtered. Change cartridge when breathing becomes difficult.
Cartridge life: sorbents	Sorbent cartridge life depends upon the amount of vapor/gas that is absorbed and what the vapor or gas is. Cartridge must be changed on a set schedule. Do not use breakthrough as a means to determine when to change the cartridge.
Oxygen	Cannot be used when the oxygen level is less than 19.5 percent.
Level of hazardous material in the air	To select the appropriate respirator, the hazardous material and its concentration level must be identified.
Immediately dangerous to life and health (IDLH)	Cannot be used in IDLH environments because of the low PFs, the limited useful duration of cartridges, and the face seal leakage. Exposures may occur.
Storage	Cartridges must stay sealed until ready-to-use. Open sorbent cartridges absorb vapors, reducing their life before they are used.
NIOSH certification	NIOSH certification is required for all respirators and cartridges. Certification is void if respirator parts from different manufacturers are interchanged.
Chemicals with poor warning properties	Cannot be used for protection against chemicals with *poor warning properties*. You cannot detect leaks or tell when the sorbent is used up.
NIOSH use limitations	NIOSH does not approve APRs for certain substances and chemicals.

The powered air purifying respirator (PAPR) has all the limitations listed in Table 4-3 plus the following two:

1. Weak batteries cause the fan motor to slow down, which delivers less air to the facepiece. The batteries require a full charge after each shift. PAPRs have a flow meter that lets you to test the air flow, and thus, the battery charge.

2. Under heavy work conditions, you can overbreath the PAPR, which creates a negative pressure in the facepiece. When overbreathing occurs, a PAPR functions just like a negative pressure full-face respirator.

FILTERING DEVICES

Air purifying respirators are manufactured with two basic types of filtering devices:

1. Particulate filters
2. Vapor and gas removing canisters and cartridges

Particulate Filters

Particulate filter respirators use a filter made of a fibrous material to capture contaminant particles before the air reaches your lungs. Particles are pulled through the filter as you inhale and become trapped by the fibers of the filter.

There are nine classes of particulate filters. The nine classes have three levels of filter efficiency and three categories of resistance to filter efficiency degradation. The three levels of efficiency are 95 percent, 99 percent, and 100 percent. The three categories of resistance are labeled N, R, and P.

N series filters have the following characteristics:

- Used for water-based particulates.
- Not resistant to oil. Cannot be used in an atmosphere containing oil or for oil-based particulates.
- Can be used for more than one work shift if there are no problems with hygiene, damage, or breathing.

R series filters have the following characteristics:

- Used for solid or liquid particles.
- Resistant to oil but not oil proof.
- Can be used for an extended time in an oil-free atmosphere.
- Has limited use time in an environment containing oil (one 8-hour shift or a combined total of 8 hours.)

P series filters have the following characteristics:

- Used for solid or liquid particles, both oil-based and non-oil based.

NIOSH update to selection guide: Originally, it was assumed P-series filters would not degrade from oil exposure and would only need to be changed when breathing resistance, hygiene concerns, or filter damaged occurred. However, a recent NIOSH study indicates the P-series particulate filter may lose efficiency with long-term exposure to oil. Therefore, NIOSH recommends replacing any P-filter that has been exposed to oil after the work shift. No changes were made to the selection logic for the N and R series filters.

Vapor and Gas Removing Canisters and Cartridges

Vapor and gas removing cartridges and canisters are used with APRs to protect you from exposures to toxic vapors and gases. Contaminants are removed as the inhaled air enters the cartridge or canister and passes through a granular material called a *sorbent*. The sorbent absorbs the contaminants and provides protection from the toxic effects of the gas or vapor.

Use and Limitations

It is critical that you use the appropriate filter or cartridge for the type of contaminant in your work area. In many cases, a wrong cartridge provides no protection at all. It is also important to know that cartridges are not inter-changeable from one manufacturer to another. When wearing Mine Safety Appliance (*MSA*) respirators, you must use the filters and cartridges manufactured by MSA for that respirator. The IH or safety and health officer (*S&HO*) will specify the correct filter or cartridge to use. Never change to a different type of filter or cartridge unless instructed to do so by the IH or S&HO.

ATMOSPHERE SUPPLYING RESPIRATORS

There are two types of atmosphere supplying respirators—supplied air respirators (SAR) and self-contained breathing apparatus (*SCBA*).

The basic difference between the respirators is the way air is delivered to the facepiece. Both the SAR and the SCBA deliver air from a high pressure source to the facepiece. Regulators are used to reduce the pressure and control the flow of air into the facepiece. There are two types of regulators:

- Demand flow
- Pressure demand

Demand Flow vs. Pressure Demand Regulators

A demand flow regulator uses the suction force of inhalation to open the regulator valve and let air flow into the facepiece. The advantage of the demand flow regulator is that the air supply is not wasted, so the time allowed by the tank is maximized. The disadvantage is that the regulator depends on negative air conditions during inhalation.

Pressure demand regulators are similar to demand flow regulators in that airflow into the facepiece occurs mainly during inhalation. However, there is also a constant flow of air into the facepiece that keeps it pressurized. So, negative pressure conditions never exist, even during inhalation. Instead, positive pressure conditions exist at all times, and leakage is minimized.

Supplied Air Respirators

Supplied air respirators (SARs) are available with:

- Half-facepieces
- Full-facepieces
- Hoods
- Helmets

SARs supply air to a facepiece through a length of hose (Figure 4-3). The hose is connected to a compressed air cylinder or to a compressor that purifies the air.

Figure 4-3. SARs receive air from compressed air cylinders or air compressors.

SARs used on hazardous waste sites should be pressure-demand types with tight-fitting, full-facepieces. These respirators provide the maximum protection. Continuous flow respirators offer no more protection than negative pressure APRs and cannot be used in IDLH environments. Pressure-demand SARs can be used in IDLH environments only in combination with an escape SCBA. The IH or S&HO will provide instructions if SARs are needed.

Limitations of Supplied Air Respirators

SARs have the following limitations:

- PF is low (25 to 50) for continuous flow. A PF of at least 2,000 is assigned for pressure-demand SARs with a full facepiece and 10,000 when attached to an escape SCBA.
- Air supply must meet government specifications for quality. If air is provided by a compressor, alarms are required to warn of the presence of carbon monoxide or other contaminants that may enter the system.
- The air-line hose limits mobility and may increase the work rate of some tasks. Take care to avoid cuts, separation, or hose damage.
- OSHA stipulates that the air line cannot exceed 300 feet. Some manufacturers may require even shorter air line lengths.
- NIOSH certification is required. Air-line attachments through suits must also be NIOSH certified.
- Do **not** interchange hoses among different makes or types of respirators unless specifically allowed by the manufacturer.

Self-Contained Breathing Apparatus

The self-contained breathing apparatus (SCBA) is available in two types:

- Open-circuit
- Closed-circuit

SCBAs must be pressure-demand respirators. A pressure-demand SCBA has a higher PF because there is always positive pressure in the facepiece. Only pressure-demand units shall be used on hazardous waste.

Open-Circuit SCBAs

Open-circuit SCBAs provide breathable air to the facepiece from a high pressure bottle. When you exhale, the air goes through an exhalation valve directly to the outside air.

An open-circuit SCBA has either a 30-, 45-, or 60-minute duration. The 30-minute unit weighs about 25 pounds and the 60-minute unit weighs about 35 pounds.

Two types of pressure-demand, open-circuit SCBAs are used on hazardous waste sites. They are:

- Regular 30-, 45-, or 60-minute SCBAs.
- Escape SCBAs used with SARs for emergency exits. (Units vary in duration from 5 to 15 minutes.)

Regular SCBAs have cylinders rated at different pressures, either 2,216 pounds per square inch gauge (*psig*) or 4,500 psig. Most SCBAs at hazardous waste sites are 2,216 psig units.

Low and high pressure cylinders cannot be interchanged on an SCBA. Take special care when recharging (filling) cylinders. Do **not** charge a 2,216 psig cylinder to 4,500 psig.

Closed-Circuit SCBAs

Closed-circuit SCBAs are also called rebreathers. With rebreathers, your exhaled breath goes back into the respirator backpack where it is scrubbed of carbon dioxide. Then oxygen is added to bring the level of oxygen up to the level available in breathing air.

Rebreathers typically use demand regulators, which means they have a lower PF. This type of rebreather cannot be used for hazardous waste work. However, some companies make rebreathers with pressure-demand regulators, which gives the rebreathers a PF of 10,000.

The actual use time for both types of SCBAs varies, depending upon the individual and the level of work intensity. For example, a 30-minute SCBA may only last 15 minutes at a high work rate.

An important element to check when inspecting an SCBA is the low air alarm. Always make sure the low air alarm is working before using the SCBA.

NIOSH CERTIFICATION

All respirators used at a hazardous waste site must be certified by NIOSH. Every certified respirator has a certification label attached to the unit or its shipping container. Under no circumstances should you use a respirator you are unsure of, whether the respirator is certified or not.

RESPIRATOR PROGRAM REQUIREMENTS

OSHA 29 CFR 1910.134 governs general requirements for respirator usage (Appendix C). The respiratory protection program must cover certain required work site-specific procedures for respirator use. Also it must be updated when there are changes in workplace conditions that affect respirator use. The respiratory protection program includes the following requirements:

1. Procedures for selecting respirators for use in the workplace.

2. Medical evaluations of employees who are required to use respirators.

3. Fit testing procedures for tight-fitting respirators.

4. Procedures for proper use of respirators in routine situations and reasonably foreseeable emergencies.

5. Procedures and schedules for cleaning, storing, inspecting, repairing, discarding, and otherwise maintaining respirators.

6. Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere supplying respirators.

7. Employee training in the respiratory hazards to which they are potentially exposed during routine and emergency situations.

8. Employee training in the proper use of respirators, including:

   - *Donning* and *doffing*
   - Limitations
   - Maintenance

9. Procedures for regularly evaluating the effectiveness of the program.

FIT TESTING

All tight fitting respirators must be fit tested. This includes dust masks, half and full-face APRs, and all tight fitting atmosphere supplying respirators. An indication of respirator fit can be determined by qualitative fit testing and quantitative fit testing.

Qualitative Test

A *qualitative fit test* (*QLFT*) is a pass/fail test to assess the adequacy of respirator fit. It relies on your response to the test agent. This test uses banana oil, irritant smoke, Bitrex® or saccharin aerosol to detect leaks caused by an improper respirator fit. A QLFT is the minimum test that can be given to test respirator fit.

Quantitative Test

A *quantitative fit test* (*QNFT*) is the best respirator fit test. It gives a numerical measurement of the amount of leakage in the respirator**.** QNFT machines are becoming more affordable and the test results are more accurate than QLFT. You may see this test done on your job site.

SEAL CHECKS

You must select and adjust your respirator each time you put it on to ensure the best possible seal. There are two common procedures used to seal check a facepiece seal—the positive pressure check and the negative pressure check.

Positive Pressure Check

To perform a positive pressure check, follow these steps:

1. Cover the exhalation valve of the respirator (Figure 4-4).

2. Exhale gently for about 10 seconds. Do not exhale too hard or push the mask into the face. Either situation will cause the check to be inaccurate.

If the respirator fits, a slight pressure should build up inside the facepiece. If air leaks out, the respirator does not fit properly and the seal is inadequate.

Negative Pressure Check

To perform a negative pressure check, follow these steps:

1. Cover the filter openings with the palms of hands (Figure 4-5). Do **not** push the respirator into your face too hard, or the check will be inaccurate.

2. Inhale gently and hold your breath for about 10 seconds.

If the respirator fits correctly, it should collapse slightly inward. If the respirator does not fit correctly, it will not collapse, and you will feel an air leak.

This test is done on SCBAs by covering the air inlet with your hand and inhaling and exhaling.

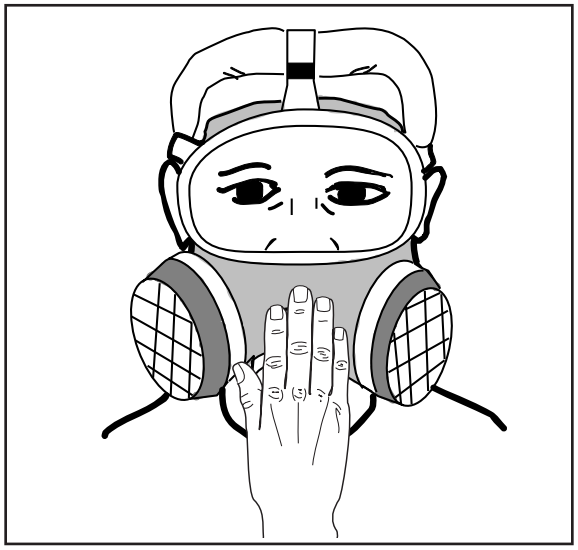

Figure 4-4. Positive pressure seal check.

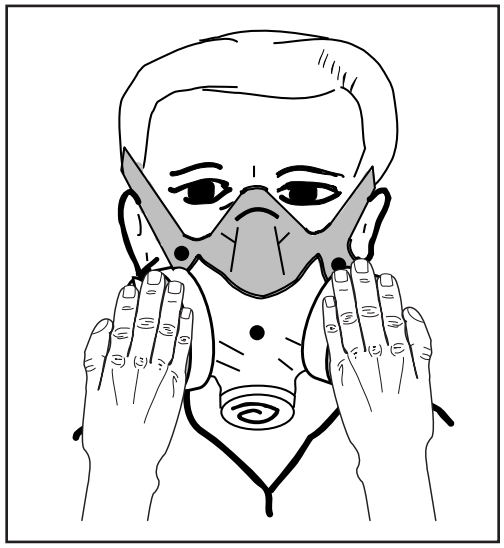

Figure 4-5. Negative pressure seal check.

CHEMICAL PROTECTIVE CLOTHING

Chemical protective clothing (*CPC*) is commonly used on waste site jobs to protect workers against skin exposures to chemicals. Although inhalation is the most common route of entry and has the highest potential for chemical exposure, awareness of skin exposure is also important. Some chemicals burn or irritate the skin. Other chemicals are absorbed without causing any warning pain or redness. Once these chemicals are absorbed into the skin, they can damage other organs, such as the liver.

Types of Chemical Protective Clothing

There are many different types CPC available. They are summarized in Table 4-4. Examples of CPC include:

- Whole body protective suits
- Gloves
- Boots
- Face shields and goggles

TABLE 4-4. Chemical protective clothing

Type	Application
Fully encapsulating suits	Chemical protection for the whole body. Used with SCBA or air-line SAR with emergency back-up unit. Integral boots and attached gloves included. Provides maximum protection. Can be deconned and reused.
Splash suits	Chemical resistant jacket with hood and pants. Separate gloves and boots also worn with this gear. Sleeves and cuffs taped to gloves and boots for added splash protection.
Aprons, leggings, and sleeve protectors	Chemical resistant materials provide added chemical splash protection
Boots	Combination heavy duty safety boots with chemical resistant material construction. Special types, such as non-conducting, are available for required applications. Chemical-resistant over-boots are commonly used to protect these boots. Over-boots are discarded after each use.
Gloves	Gloves are made from many different chemical resistant materials, of varying thicknesses, and in several lengths. On waste sites, double gloving is normal practice to protect against skin exposure if a glove tears or is punctured.
Faceshields	Where chemical splashing is possible, faceshields protect the neck, face, and forehead. Faceshields are often attached to hard hats.

Leakage Issues

Like respirators, CPC has limitations. The biggest limitation is leakage. For respirators, much of the leakage has to do with how well the facepiece fits. For gloves and protective clothing, the leakage has to do with chemicals passing through the protective barrier of the clothing. In this way, the leakage issue is like the issue of chemical breakthrough with respirator filters. There are three important terms to know about when discussing leakage and the protection offered by CPC:

1. Permeation
2. Degradation
3. Penetration

Permeation

Permeation is the process of a chemical passing into the chemical structure of a material and through to the other side. Although CPC provides a barrier, some chemicals can eventually pass through. The length of time it takes a chemical to permeate depends on the chemical properties. Permeation may not be detected by looking at a piece of protective clothing.

Degradation

Degradation is the process of a chemical changing the material so that it loses its effectiveness as a barrier. (The chemical breaks down the clothing material.) Sometimes degradation can be seen. The material may be puckered, brittle, or eroded. Chemicals, sunlight, and high temperatures all can cause degradation.

Penetration

Penetration is the ability of a chemical to pass through a garment by way of openings in the material. Examples include pin holes, imperfections in the material, zippers, and seams.

Data is available from the manufacturer on permeation and degradation of CPC. However, a scoring system, like PFs for respirators, does not yet exist for CPC. Most protective clothing manufacturers issue permeation guides for their products. Because different types of plastic and rubber provide different levels of resistance against permeation and degradation, manufacturers make gloves and suits out of several types of materials.

NONCHEMICAL PROTECTIVE CLOTHING

There can be other types of hazards on a waste site or spill scene other than chemicals. For nonchemical hazards there are specialized types of PPE, such as:

- Firefighting gear
- Proximity or approach garments
- Blast and fragmentation suits
- Flotation gear
- Cooling garments

TABLE 4-5. Nonchemical protective clothing.

Type	Application
Hard hat	Required on any construction site. Worn under chemical protective clothing where chemical protection is required.
Hearing protection	May be required in selected tasks. Worn as ear plugs or muffs as specified by IH or S&HO.
Firefighting, turn out gear	Coat, pants, hat, gloves, and boots. Thermal protection but no chemical protection. If splashed with chemical, cannot be deconned using normal site decon procedures.
Proximity suits	Protection against high radiant heat exposures. Not a chemical PPE.
Blast suits	Protection against blast and fragmentation. Not chemical resistant. Cannot be easily deconned if exposed to chemicals.
Radiation suits	May be required on some sites. Use only as directed by the IH or S&HO. Special use restrictions merit care.
Flotation gear	May be required at some sites. Worn as directed by IH or S&HO when working around water. They are not chemical resistant.
Cooling garments	May be used at some sites. Different types available, some battery powered, others with cold block sleeves. Use with chemical protective clothing as directed by IH or S&HO. Usually worn close to the body under other equipment for maximum efficiency. Limited usefulness particularly at heavy work rates when they provide little, if any, benefit.

PROTECTIVE ENSEMBLES

A specific respirator paired with a type of protective clothing is called an *ensemble*. Occupational health specialists have developed four basic ensembles for working on hazardous waste sites. The four levels are summarized below.

1. Level A – Highest level of protection. Consists of a fully-encapsulating, vapor and gas-proof suit with an atmosphere supplying respirator. Used when chemical exposures are expected to be high.

2. Level B – Consists of atmosphere supplying respirator and chemical splash suit. Provides moderate skin protection. Used when vapor or gas levels are not high enough to be a hazard to the skin. Minimum level of protection used for unknown contaminants.

3. Level C – Consists of a full-face APR and chemical splash suit. Used when airborne chemical levels are reliably known and adequate chemical filters are available.

4. Level D – Lowest level of protection. No respirator. Minimal skin protection.

Determining the PPE Level

The hazard assessment carried out during development of the Site Safety and Health Plan establishes the levels of PPE to be used during the cleanup. But a site hazard assessment is an ongoing task. Thus changes are made, especially as the job progresses. The S&HO is responsible for making PPE decisions. Typical factors considered for a change to a lower PPE level are:

- New information showing less hazardous conditions
- Change in site conditions that reduces the hazard
- Change in task that reduces contact with hazardous materials

Factors considered for changing to a higher PPE level are:

- Known or suspected skin hazards
- Likely occurrence of gas or vapors being given off
- Change in task that increases contact with hazardous materials
- Worker request

USING PERSONAL PROTECTIVE EQUIPMENT

Training is critical to the safe and proper use of PPE for the following reasons:

- Workers become familiar with PPE operation in a safe environment.
- Workers learn their own limitations when wearing PPE.
- A worker becomes more skilled at doing a job while wearing PPE.
- Needless wear and tear on the PPE is reduced.
- Accidental exposures on the job are reduced.

Even though this course provides experience with PPE, site specific training is important. There may be important differences between manufacturers.

Work Mission Duration

Many different factors must be considered in planning how work will be done, and how long each work mission will take. On a typical construction job, a work shift is eight hours long, with breaks and lunch along the way. But the structure of a work day on a waste site is very different, especially if SCBAs are used. On a waste site, jobs must be divided into missions to match the length of time the air supply will last. You need to allow at least enough time to do the following:

1. Put on your respirator
2. Travel from the dress out area to the job area
3. Return to the decon area and be decontaminated

Work time is the amount of time left after factoring in the above actions. So the actual work task must be well planned. However, several factors can affect the length of work time. They include:

- Work rate
- Fitness level
- Body size
- Breathing patterns
- Outside temperatures
- Coolant supply

Work Rate	The more strenuous the work, the faster and heavier a worker breathes. The air supply is used up quicker, and the work time is reduced. Heavy work reduces the in-use duration of SCBAs by 1/3 to 1/2. In other words, 30 minutes of air is reduced to 20 or 15 minutes of air.
Fitness Level	The better the physical shape a worker is in, the more oxygen the body uses from a given amount of air. Their systems are more efficient. Therefore, an air supply will last a bit longer for more physically fit workers.
Body Size	Larger workers normally use air faster than smaller workers.
Breathing Patterns	Quick, shallow, irregular breathing uses air more quickly than deep, regular breaths. Workers who become sick, anxious, or uncomfortable use air more quickly.
Outside Temperatures	Workers who are heat stressed may breath faster, so they use air at a faster rate. Also hot and cold temperatures can affect how well the suit and respirator work which then affects the work mission. The following are examples: • Valves on suits and masks may not operate as well • Suits may become less durable or flexible • Fasteners may not work well • Chemical breakthrough times may be affected • Airborne chemical levels may be affected
Coolant Supply	Sometimes cooling units are used under warm or strenuous conditions. So the coolant supply time can also limit the duration of the work mission.
Personal Use Factors	Several items can affect the protection provided by PPE. It's important that workers are aware of these items. They include the following: • Facial hair • Long hair • Eyeglasses • Contact lenses • Gum and tobacco chewing

Facial Hair

Beards and long sideburns prevent a good seal between the face and the respirator. **Any** facial hair reduces the protection received from a respirator, including a few days growth. A mustache is acceptable if it fits under the facepiece and does not affect the seal.

Long Hair

Long hair may interfere with a good seal in some situations. The hair must be contained under the protective suit.

Eyeglasses

The temple bars that extend from the ear to the lens prevent a respirator from fitting up against the side of the head. Spectacle kits fix this problem and must be provided by the employer. **Never** hesitate to request a spectacle kit. Working without eyeglasses creates a serious risk of an accident or injury.

Contact Lenses

Contact lenses cannot be used with a respirator in a contaminated atmosphere for the following reasons:

- A contact lens is porous. It can absorb chemicals causing the chemicals to contact the eye. This can lead to eye injury.
- Sometimes the humidity inside the mask can be very low or very high. The degree of humidity affects the ability to wear contact lens comfortably.
- If the lenses were to pop out of the eye in a hazardous area, the worker might be put into a dangerous situation. There would be no way to put the lens back in without taking off the respirator.

Gum and Tobacco Chewing

Gum and tobacco chewing are prohibited when wearing a respirator. The chewing action puts a strain on the respirator seal. It could also lead to ingestion of contaminants.

Donning and Doffing

Donning is the act of putting on PPE. It's not difficult to put on the equipment. However, a specific routine must be followed for the best results. Assistance is usually provided by another worker, especially if a fully encapsulating suit and SCBA is involved.

Doffing is the act of removing PPE. Again, it is important to follow the specific steps when removing PPE. Doffing is made more complicated by the fact that the PPE may be contaminated.

In-Use Monitoring

When wearing PPE, workers should be alert to conditions that signal chemical exposure has occurred. These conditions include the following:

- Signs that the protective ensemble has been degraded
- Chemical odors
- Skin irritation
- Unusual fatigue
- Breathing difficulties
- Vision problems
- Restrictions in the ability to move
- Physical discomfort, rapid pulse, nausea, or chest pain

INSPECTIONS

Inspection are an important part of a good PPE program. Checklists and written records are needed to verify and maintain the effectiveness and safety of the PPE. There are different types of inspections.

1. Inspection and testing of new equipment
2. Inspection of equipment at the time it is issued to workers
3. Inspection after use
4. Periodic inspection of stored equipment
5. Inspection when problems are reported

The responsibility to inspect PPE must be assigned to a specific qualified person. However, it is a good practice for workers to know how to do a basic equipment inspection.

SECTION 4 - ASSIGNMENT SHEET

1. Define the following terms:

Degradation _____

_____

Maximum use concentration _____

_____

_____

Permeation _____

_____

_____

Penetration _____

_____

_____

Protection factor _____

_____

_____

Qualitative fit test _____

_____

_____

Quantitative fit test_____

_____

_____

2. Write out the following abbreviations:

APR _____

CPC _____

MUC _____

PAPR _____

PPE _____

SCBA _____

3. List the five types of respirators and their protection factors.

_____

_____

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4. List the limitations of negative pressure APRs.

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5. List the limitations of a full-face SAR.

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6. List the limitations of SCBAs.

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_____

7. List the PPE used in Level A.

Protective clothing:

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Respirator:

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_____

8. List the PPE used in Level B.

Protective clothing:

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_____

Respirator:

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_____

9. List the PPE used in Level C.

Protective clothing:

_____

_____

Respirator:

_____

_____

10. List the PPE used in Level D.

Protective clothing:

_____

_____

Respirator:

_____

_____

HAZARDOUS WASTE WORKER REFRESHER

Section

5

Title

DECONTAMINATION

TRAINEE OBJECTIVES

After completing Section 5, you will be able to:

1. List three reasons why workers must decontaminate.

2. List eight ways workers can avoid contamination.

3. List two methods of removing contamination from clothing and equipment and give two examples of each.

4. Describe a major reason for using condensed decontamination procedures.

INTRODUCTION

Decontamination is the process of removing or neutralizing chemical contaminants that have accumulated on protective clothing, tools, or equipment used on the job. As a hazardous waste worker, it is important for you to decontaminate to:

- Keep hazardous materials out of the clean area where personnel are not protected from chemical exposures.
- Prevent from being exposed to the chemicals on the outside of your own personal protective equipment (*PPE*) when you doff the equipment.
- Ensure that other workers will not be contaminated when the PPE is reused.

All hazardous waste sites have established site work zones. These work zones are:

- *Exclusion zone* (contaminated area)
- *Contamination reduction zone* (decontamination area)
- *Support zone* (clean area)

To cross from the exclusion zone to the clean zone, you must move through a detailed and carefully planned step-by-step decontamination procedure. It is essential that you follow the decontamination procedure, whether the procedure is exactly as taught in this course or as outlined in the site specific Safety and Health Plan.

HANDLING HAZARDOUS CHEMICALS

Contamination avoidance and contamination transfer are important concepts for you to know regarding the handling of hazardous chemicals.

Contamination Avoidance

Contamination avoidance is the process of preplanning every action involving a chemical hazard to avoid unnecessary exposure. To avoid unnecessary exposure to hazardous chemicals, you should:

- Use remote sampling and handling equipment.
- Avoid exposure through work practices. For example, do not walk through areas of obvious contamination.
- Put instruments and similar equipment in plastic bags. This practice reduces or eliminates potential exposure during the decontamination process.
- Wear protective equipment properly to receive maximum protection.
- Wear a layer of disposable clothing (e.g., Tyvek) on top of PPE.
- Maintain communication with your buddy or support staff.

To avoid unnecessary exposure to hazardous chemicals, **do not**:

- Touch barrels, equipment, and debris unless the job requires it.
- Sit on potentially contaminated soil, equipment, drums, etc.
- Be exposed to liquid or solid chemicals unless it is necessary to the work task.

Employers have a large investment in protective clothing, respirators, and equipment. Minimizing chemical exposure to this equipment prolongs its useful life.

Contamination Transfer

Contamination transfer is the act of passing contamination from one item or person to another item or person. To help prevent contamination transfer, you should:

- Doff the various levels of protective clothing with care.
- Remove clothing in the order established for the decontamination line. This process starts with removal of the most likely contaminated garments (outermost), such as outer gloves and boot covers, and works its way down to the respirator facepiece. Once outer gloves are removed, avoid touching the outside of the splash suit or fully encapsulating suit. Always assume the inner gloves are contaminated and make every effort not to touch your skin.
- Assume equipment is still contaminated even though it has been washed. Many chemicals cannot be completely removed from chemical protective clothing.

If you are a decontamination line worker, assume your equipment is contaminated. **Never** touch workers on their inner clothing or skin.

DECONTAMINATION METHODS

The two decontamination methods for removing hazardous materials from clothing and equipment are physical removal and chemical removal.

Physical Removal

Physical removal involves removing hazardous material by:

- Scraping
- Brushing
- Wiping
- Water rinsing
- Freezing with dry ice
- Evaporating with heat

Physical removal can be quite effective because many hazardous materials are solids or dirt soaked with chemicals.

Chemical Removal

Chemical removal involves removing hazardous material by:

- Water and detergent washing
- Water and bleach washing
- Dry-cleaning with freon solvent
- Airing out the suit at warm temperatures

The chemical removal method used should be specified by a qualified person who must consider the effect a cleaner has on the PPE. Air drying at warm temperatures has been reasonably effective with a few hazardous chemicals, but cannot be relied upon as a general decontamination method.

Many chemicals, especially those that have begun permeating protective clothing, cannot be completely removed from clothing using decontamination methods. Because it is difficult and time consuming to determine if PPE has been properly decontaminated, you must be sure to inspect your PPE before each use.

During the decontamination process the use of water must be kept in mind. Once water is used to decon either personnel or equipment, it must be considered contaminated. This contaminated water must be collected and disposed of in a proper manner.

DECONTAMINATION SEQUENCES

Full decontamination is the 19-station, 19-step procedure recommended by the Environmental Protection Agency *(EPA*). Although condensed decontamination procedures are commonly used on most clean-up sites, it is important to be familiar with full decontamination procedures in order to perform condensed decontamination. The difference between full and condensed decontamination is not the number of steps but the number of stations.

Each level of PPE has a basic decontamination sequence for the equipment being worn. The ensembles for each level are:

- Level A - Totally-encapsulating chemical protective suit and an atmosphere supplying respirator.
- Level B - Chemical-resistant splash suit and an atmosphere supplying respirator.
- Level C - Chemical-resistant splash suit and a full-face air purifying respirator.

Condensed decontamination procedures are commonly used at many clean-up sites. One major reason for the simplified procedure is that some protective clothing (coveralls, gloves, and boot covers) used at many current cleanups are removed and disposed of as opposed to washed, rinsed, and removed.

Figures 5-1 to 5-3 show the full decontamination procedures for PPE levels A, B, and C. Figure 5-4 to 5-6 show the condensed decontamination procedures.

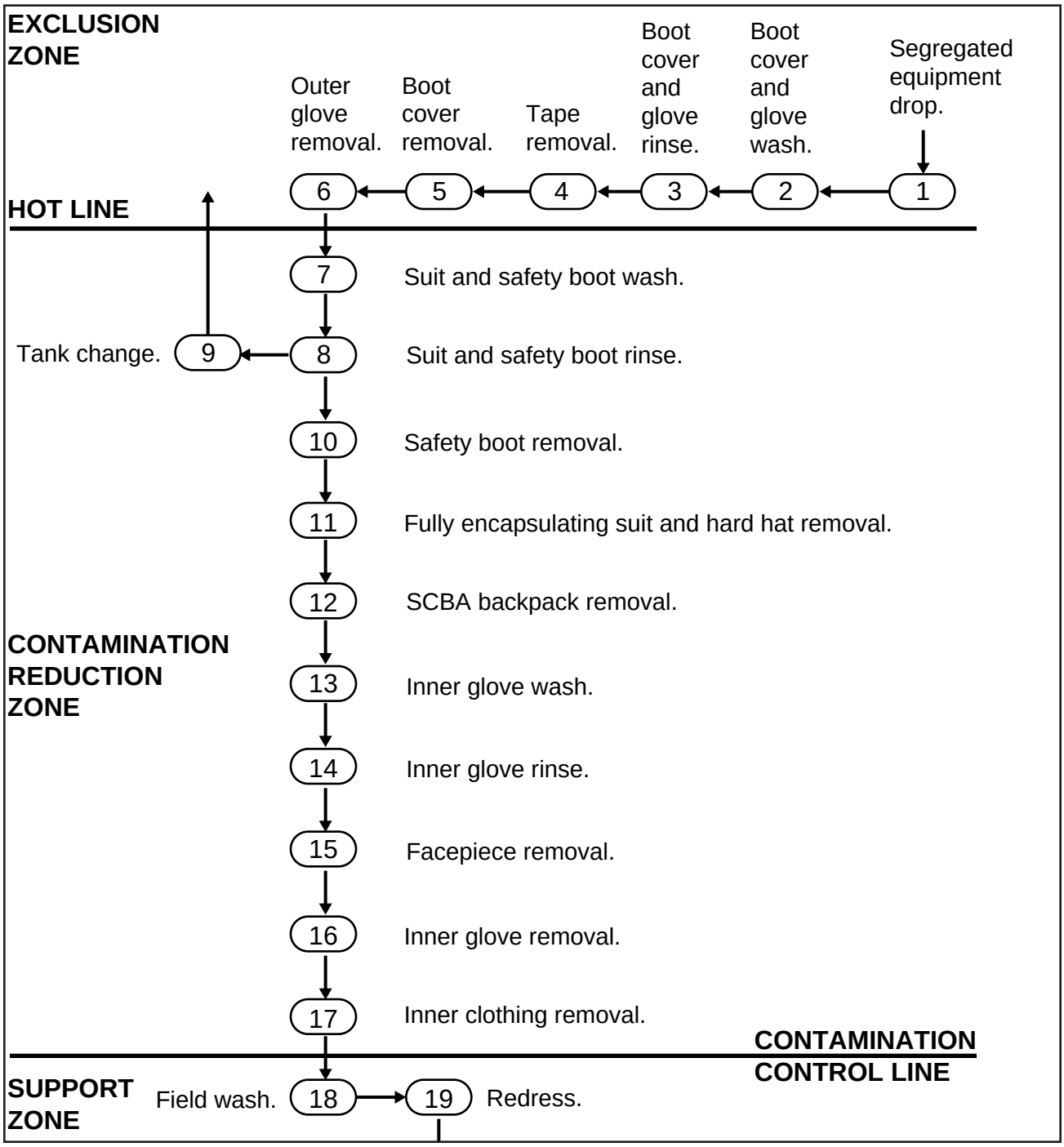

Figure 5-1. Full decontamination procedures for Level A protection.

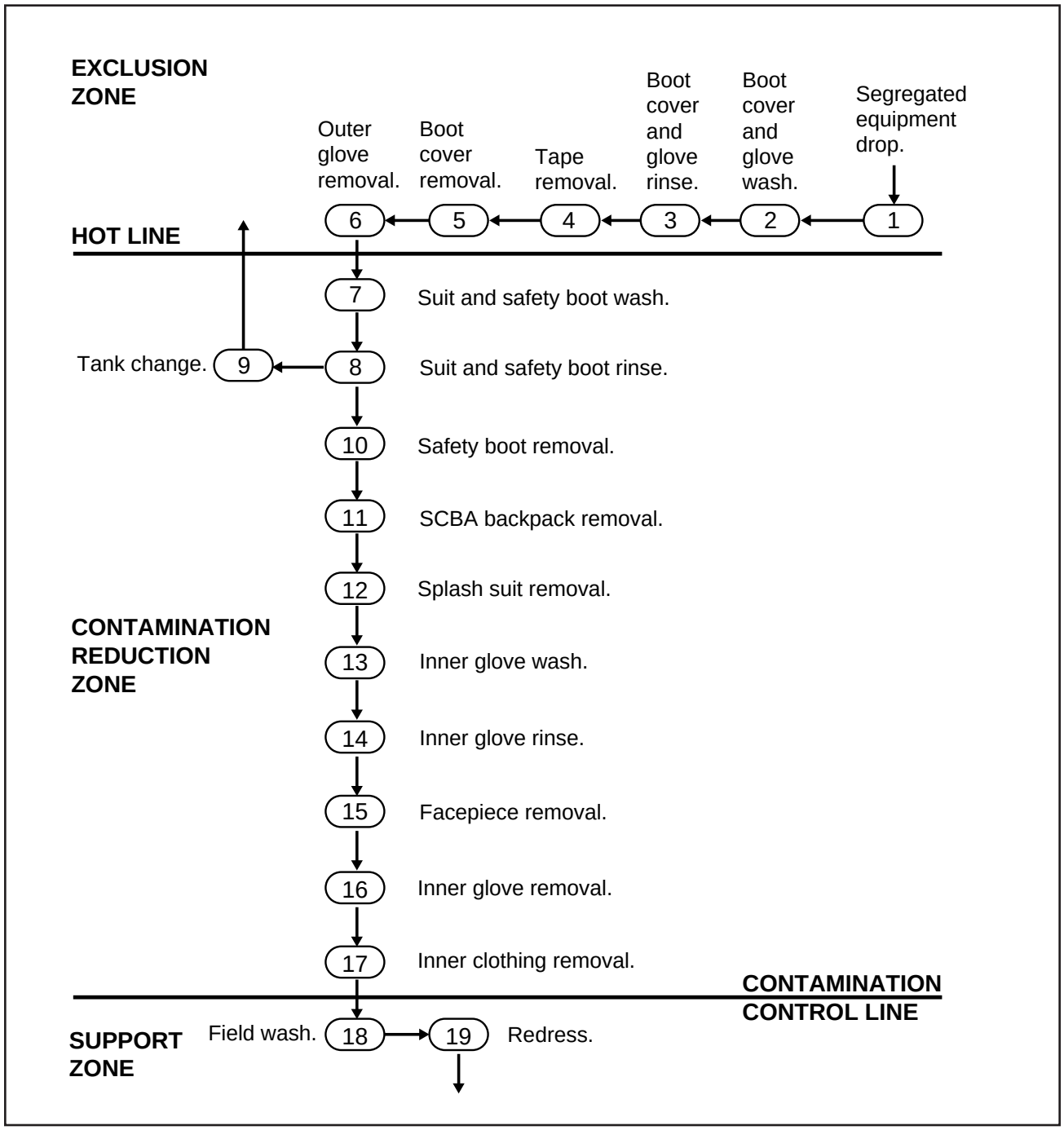

Figure 5-2. Full decontamination procedures for Level B protection.

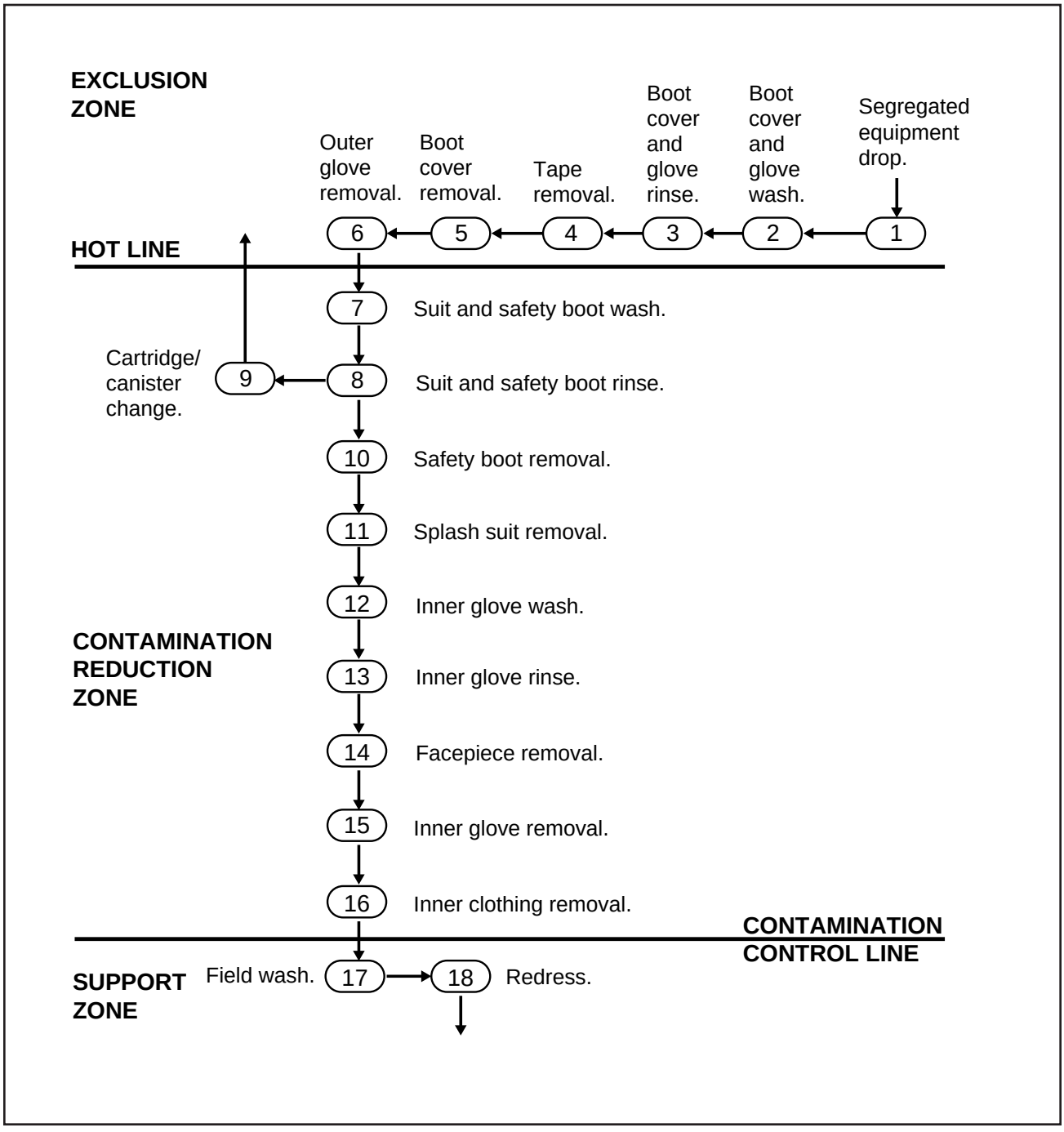

Figure 5-3. Full decontamination procedures for Level C protection.

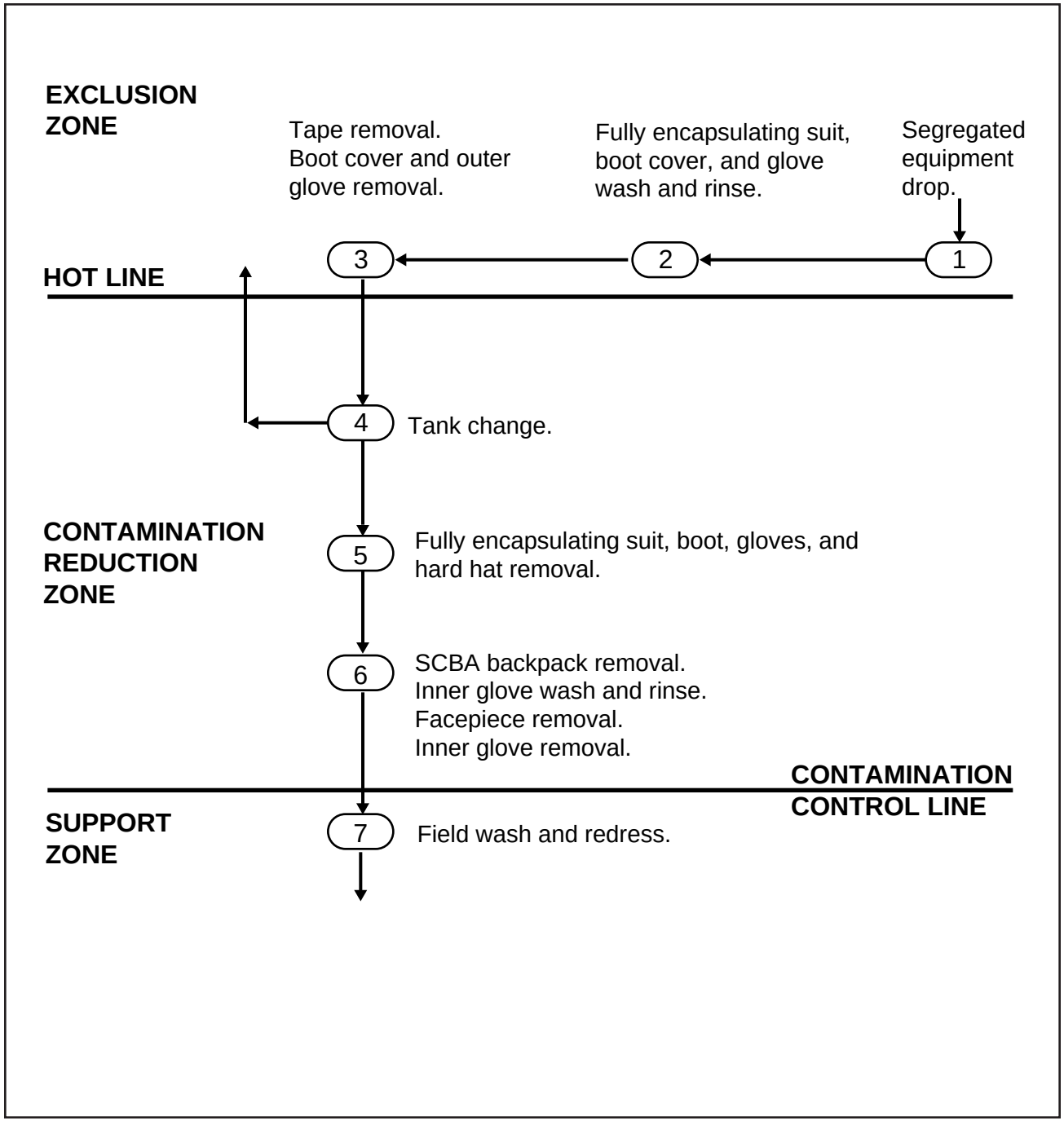

Figure 5-4. Condensed decontamination procedures for Level A protection.

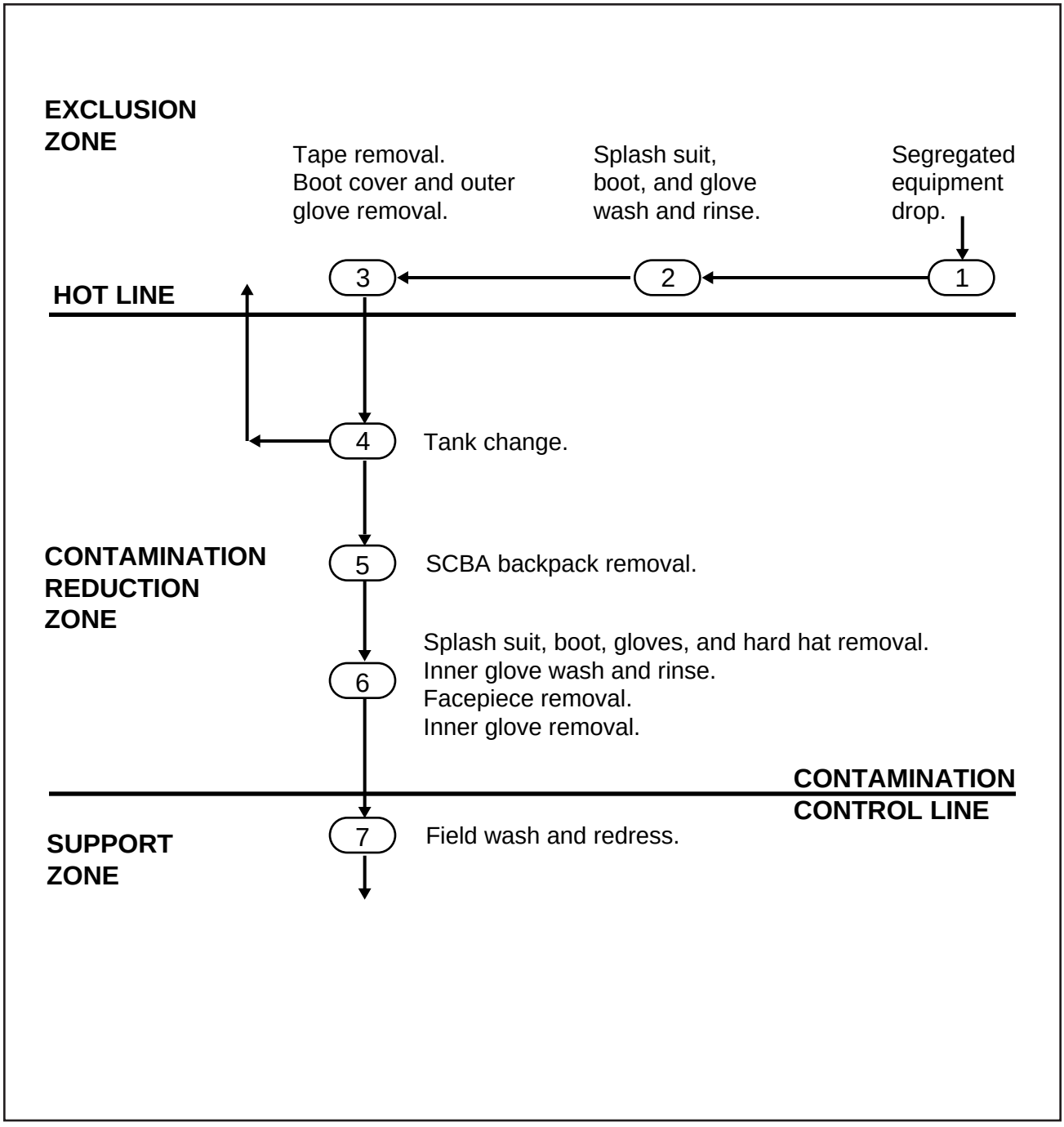

Figure 5-5. Condensed decontamination procedures for Level B protection.

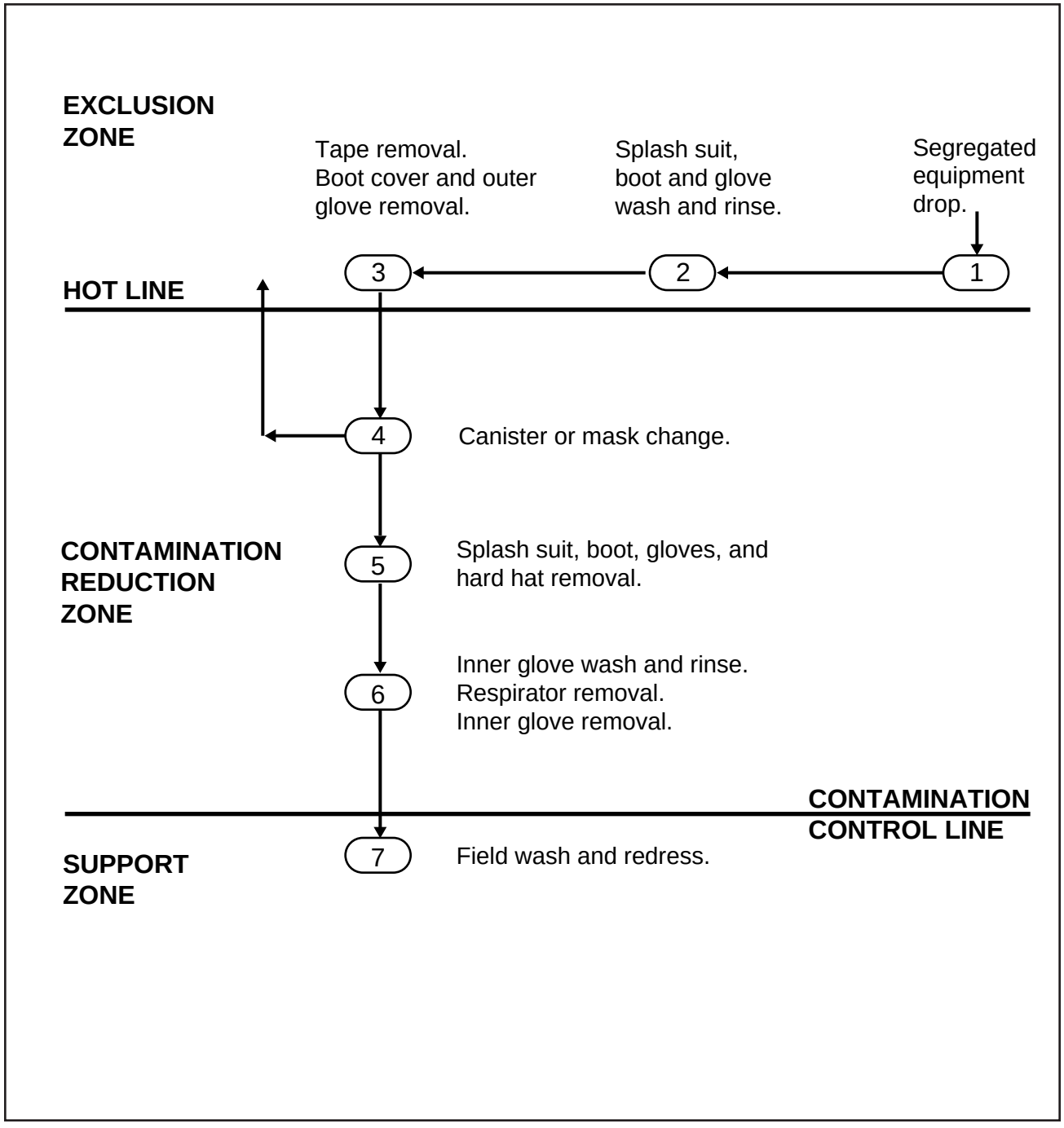

Figure 5-6. Condensed decontamination procedures for Level C protection.

EQUIPMENT DECONTAMINATION

All equipment must be decontaminated before leaving the site. Large pieces of equipment, such as backhoes, bulking chambers, and trucks, pose serious decontamination problems. High pressure steam lines are commonly used to decon these types of equipment. Sandblasting is sometimes required. Shovels, lifts, and scoops may have to be sandblasted.

Wipe tests are used to determine when decontamination has been achieved. In a wipe test, a piece of gauze or filter paper is drawn across a surface. The gauze or filter is then analyzed for chemical content. A wipe test gives data on how much chemical contamination is present on a surface.

EMERGENCY DECONTAMINATION

It is important to have emergency decontamination procedures developed and that all workers are familiar with them. The emergency procedures must be carried out using established standard operating procedures (*SOP*s). However, if immediate medical treatment is required to save a life, decontamination can wait. Listed below are three possible emergency situations.

1. Physical Injury

    - Life-threatening injuries - Start treatment immediately without decontamination. Respirators and backpacks usually need to be removed. Sometimes protective clothing must be cut away.

    - Minor medical problems or injuries - Follow the normal decontamination procedure

2. Heat Stress

    - Heat stroke: Start treatment immediately. Omit or reduce the decontamination procedures. Heat stroke is the most serious heat-related illness and can cause death.

    - Less severe heat-related disorders: Follow normal decontamination procedure.

3. Chemical Exposure

   - When contamination is the cause of the emergency, decontamination is part of the medical response. For example, a chemical burn might be flooded with water.

   - Follow decontamination procedure if medical problems are not severe.

Because every emergency is different, individual judgement must be used in each situation Teamwork, planning, and knowledge of first aid are important components of a good emergency program.

SECTION 5 - ASSIGNMENT SHEET

1. List three reasons why workers must decontaminate.

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2. List eight ways workers can avoid contamination.

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3. List two methods of removing contamination from clothing and equipment and give two examples of each.

_____

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4. Describe a major reason for using condensed decontamination procedures.

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_____

HAZARDOUS WASTE WORKER REFRESHER

Section

6

Title

SITE SAFETY AND HEALTH PLAN

TRAINEE OBJECTIVES

After completing Section 6, you will be able to:

1. List ten minimum requirements for a site safety and health plan.

2. List three work zones found on a hazardous waste site and explain the difference between them.

3. List five major sections of an emergency response procedure.

INTRODUCTION

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (*CERCLA*) and its successor law, the Superfund Amendments and Reauthorization Act of 1986 (*SARA*) are known as the Superfund laws. Acting under these laws the Environmental Protection Agency (*EPA*) has established a comprehensive program and process for cleaning up old or abandoned hazardous waste sites.

DEVELOPING THE PLAN

The actual cleanup of a hazardous waste site is called the remedial action. It is where most of the money is spent, and laborers and other workers are employed. However, before the remedial action begins, the Occupational Safety and Health Administration (*OSHA*) requires the development of a written *site safety and health plan* (the Plan) for each hazardous waste site *clean-up operation*.

In order to develop an effective Plan, information is needed. Studies are conducted on the hazardous waste site. These studies can take up to four years and aim to:

- Investigate the site
- Identify the hazards
- Develop a cost-effective clean-up method

Information regarding the area around the site is collected. For example:

- Neighboring homes, communities, animals.
- Land use, such as agriculture, fishing, and hunting.
- *Topography* and soil type.
- Weather conditions, such as rainfall, storms, and temperatures.
- Water, both surface and groundwater.

In addition, OSHA regulations require that the Plan be:

- Developed before any work begins at a site.
- Made available for workers to read and understand before they enter the site to do any work.
- Revised and updated on a regular basis when new information becomes available.

The Plan is called a living document because it changes throughout the entire life of the job. In spite of all the investigations and studies that go on before the cleanup begins, changes will occur as the cleanup progresses. For example, there will be:

- Different work methods developed
- New findings at the site
- New safety and health data
- Organizational revisions

The key actions you should take regarding the Plan include:

- Read and understand the Plan before you start work.
- Ask the site safety and health officer (*S&HO*) or supervisor to answer any questions you may have.
- Follow any changes made in the Plan.

Plan Content

By law, the Plan must include a minimum amount of information. The list below describes each of the ten basic points the Plan must cover.

1. Hazard analysis - A safety and health risk analysis for each site task and/or operation described in the work plan.
2. Training - A description of the worker training required, including any special training for specific tasks.

3. Personal protective equipment (*PPE*) - A description of PPE requirements for each site task and operation.

4. Medical surveillance - Regular physical examination requirements, plus any specific or special medical monitoring required.

5. Monitoring - Air monitoring, personnel monitoring, and environmental sampling requirements and methods.

6. Site control - Site control program and procedures.

7. Decontamination procedures - All phases of decontamination, including procedures, areas, equipment, rules, and monitoring.

8. Emergency response plan - Written response plan for all site emergencies including roles of local, state, and federal agencies or organizations.

9. Confined space entry procedure - A procedure specific to each hazardous waste site and confined space on the site. The procedure describes methods of atmospheric testing, permits, and specific training needs.

10. Procedures to be followed for containing and isolating spills.

Plans for different hazardous waste sites can contain similar information. For example:

- Decontamination line setup and procedures
- Equipment for air monitoring
- Medical monitoring
- PPE

How these common items are used or applied will differ from site to site. The differences depend on the materials, hazards, and site features that are characteristic to the particular site.

PERSONNEL

The Plan includes a listing of key personnel assigned to various site operations or responsibilities, including:

- Safety and health officer
- Emergency coordinator
- Decontamination station coordinator
- Project manager
- Fire and rescue squads

Safety and Health Officer

By law, the Site Safety and Health Program is required to designate one person at the site as the S&HO. Although the S&HO can have other duties, safety and health at the site are his or her primary concern. The S&HO has the overall responsibility for implementing the Plan and approving any changes, modifications, or additions to it. The S&HO has authority to:

- Upgrade protection levels.
- Suspend work due to safety and health violations.
- Remove workers if their actions endanger other workers.
- Authorize personnel to enter the site based on medical and training requirements.

Some of the S&HO's responsibilities include the following:

- Conduct site inspections
- Coordinate medical monitoring program
- Coordinate training sessions
- Direct on-site health and safety activities
- Report safety-related accidents to the project manager

The S&HO should have a designated alternate who can take over in his or her absence. It is important for the S&HO or alternate to be available on the site at all times. If conditions change at the site, it is the S&HO or alternate who makes the appropriate changes in the Plan. However, it is everyone's responsibility to report site changes. If you observe or detect changes in the site situation, contact the S&HO and your supervisor.

TRAINING

The training section of the Plan outlines three types of training for the hazardous waste worker:

- Hazardous waste
- Site specific
- Emergency response

Hazardous Waste Training

OSHA requires a minimum of 40 hours off-site instruction and an annual eight-hour refresher course to be qualified to work as a hazardous waste worker. (By comparison, the Laborers-AGC Hazardous Waste Worker course is 80 hours.)

Site Specific Training

When you report to a site, you must receive three days of site specific training and field experience under a qualified supervisor.

Emergency Response Training

If you are responsible for responding to emergency situations at a hazardous waste clean-up site, you shall be trained to respond to such emergencies.

SITE CONTROL

The S&HO establishes a site control program to control the activities and movements of workers and equipment at the site. The goals of the site control program are to:

- Reduce worker and public exposure to chemical, biological, and safety hazards.
- Prevent site vandalism that could threaten public and worker health.
- Limit damage to the environment.

The following activities are examples of how the S&HO achieves his or her goals:

- Develop a site map
- Establish site work zones
- Use the buddy system
- Establish and enforce decontamination procedures for personnel and equipment
- Establish security measures
- Set up a communication system

Site Map

The site map shows:

- Drainage
- Location of buildings, containers, pits, ponds, tanks
- Prevailing wind direction
- Topographic features

Showing these features on the site map helps the S&HO to:

- Assign workers
- Identify access/evacuation routes and problem areas
- Identify areas requiring PPE
- Plan

Site Work Zones

An established method for preventing or reducing the movement of contaminants is to identify zones on the site in which various types of operations take place. Movement of personnel between these zones, and onto the site itself, can be limited by access control points. Normally three adjoining zones are used (Figure 6-1).

- *Exclusion zone* - Contaminated area.

- *Contamination reduction zone* - Area between the contaminated area and the clean area.

- *Support zone* - Uncontaminated area where workers should not be exposed to hazardous conditions.

Exclusion Zone

The exclusion zone is the innermost of the two areas where contamination occurs. All personnel entering this zone must wear the appropriate level of protection.

The outer boundary is called the *hotline*. Entry and exit points, called *access control points*, are established at this line to regulate the passage of people and equipment in and out of the zone.

There can be subareas within the exclusion zone where different levels of PPE are required. For example, the minimum required level of protection to enter the exclusion zone might be Level C. However, within the zone, there might be a subarea where Level B is required.

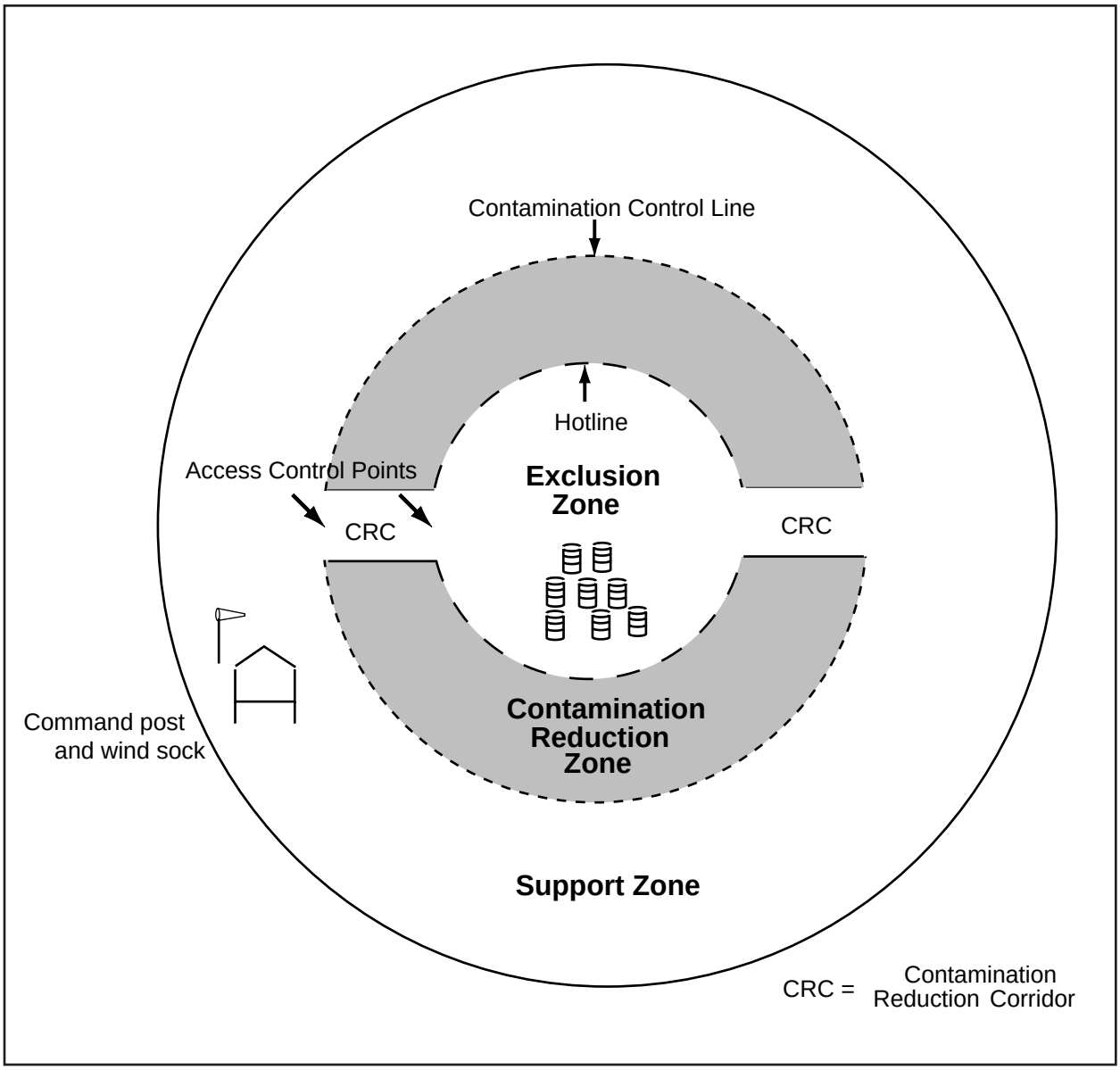

Figure 6-1. A hazardous waste site has three work zones and at least two contamination reduction corridors.

Contamination Reduction Zone

The contamination reduction zone (CRZ) is the zone between the exclusion zone and the support zone that provides a transition between contaminated and clean zones. It further reduces the possibility of the clean zone becoming contaminated.

Decontamination procedures take place in designated areas within the CRZ called *contamination reduction corridors* (CRC). There should be at least two CRCs, one for personnel and one for equipment. They begin at the hotline and end at the support zone.

The boundary between the support zone and the CRZ is called the contamination control line. Access to the CRZ from the support zone is through an access control point. Personnel entering this area wear the prescribed PPE.

Support Zone

Leaving the CRZ for the support zone requires removal of any PPE worn in the CRZ. The support zone is considered a non-contaminated or clean area. Typical facilities located in the support zone are:

- Command post
- Equipment storage
- Lockers and showers
- Lunch and sanitary facilities.
- Medical and/or first-aid facilities

Buddy System

Activities in contaminated, or other-wise hazardous areas, are conducted with a buddy or a team who:

- Provides each other with assistance.
- Observes others for signs of heat stress or chemical exposure.
- Checks the protective clothing of the others periodically.
- Notifies the command post or others if emergency help is needed.

The buddy system helps to reduce dangerous situations, but it cannot always ensure help will be provided in an emergency. When in the exclusion zone, you and your buddy should always be in visual contact or communication with the command post personnel or a backup person in the support zone.

EMERGENCY RESPONSE PLAN

The causes of emergencies can be divided into two basic types—waste-related emergencies and worker and site-related emergencies.

Waste-Related Emergencies

Waste-related emergencies include the following situations:

- Collapse of containers
- Discovery of radioactive materials
- Explosion
- Fire
- Leaks and spills
- Reaction of incompatible chemicals
- Release of toxic vapors

Worker- and Site-Related Emergencies

Worker and site-related emergencies include the following situations:

- Chemical exposure
- Major accident (vehicle accident or electrocution)
- Minor accident (slip or fall)
- PPE failure
- Stress problem (heat or cold)

Advanced Planning

The best way to deal with emergencies is to plan ahead by developing an emergency response plan. The important elements of an emergency response plan are described below.

Chain of Command

The plan must identify all the individuals and teams that will participate in emergency operations. It should also include off-site support teams, such as ambulance services, firefighters, and other contacts.

Site Map

To avoid any confusion, it is important to have a site map ready at all times for use in emergencies.

Communication and Locator Systems

In an emergency, effective communication is critical. The emergency response plan must address this issue with an effective system. It is important that the method chosen be clearly understood by all, as well as practiced and used in drills.

Any sound emergency response plan needs a locator system. The names and location of the crew going on the site are listed on the entry board and taken off when the crew leaves the site. The locator system must be:

- Written
- Kept current
- Located outside of the *hot zone*
- Easy to find
- Simple enough to allow you to identify the crew's location

The checkpoint control person records the following information:

- Name of worker
- Status (in or out)
- Time of entry
- Anticipated exit time
- Zone or area to be entered
- Name of buddy or team
- Task to be performed

Equipment Needs

The emergency response plan must address the need for rescue equipment. It must describe where such equipment is kept and when it is to be used.

Training and Drills

An emergency response plan is not meaningful unless training and drills are conducted on a regular basis. The drills must:

- Be related to emergencies possible at that particular site
- Be brief, repeated often, and unannounced
- Provide an opportunity for skills to be practiced
- Be as realistic as possible
- Include everyone

Providing Protection

There are three different ways to provide protection in the site area:

- Escape routes
- Safety stations
- Evacuation to a safe distance

Escape Routes

Escape routes must be posted and marked on the site map so that work crews can make note of them as they enter the work area. The routes should be changed when necessary because of wind direction, etc.

Refuges

A refuge is a safety station set up to provide relief in an emergency situation that is not critical or life threatening. For example, the refuge can be used to take a short break to prevent heat stress. A refuge contains:

- Bolt cutters and hand tools
- Communication equipment
- Fire extinguishers
- First-aid supplies
- Sitting or resting area, shaded if possible
- Special air monitoring devices
- Water for decontamination
- Wind indicator

Safe Distances

In some types of emergencies where chemical releases are likely, evacuation can involve moving to a safe distance away from the chemical. Safe distances for typical and worst case situations are sometimes developed as part of emergency response plans.

Emergency Response Procedure

An emergency response procedure outlines the steps to take to ensure a response is done in an orderly manner.

1. **Notification.** It is important to supply the following information when reporting a problem:

   - What happened?
   - Where did it happen?
   - Who is/are the victim(s)?
   - When did it happen?
   - How did it happen?
   - What is the extent of the problem?
   - What help is needed?

2. **Evaluation.** The chain of command must answer the following questions:

   - What type of incident occurred?
   - What are the casualties?
   - What could happen next?
   - What can be done to deal with the situation?

3. **Request for assistance.** A prearranged system must be in place and used during an emergency. Back-up responders should also be prearranged in case the first responders are unavailable.

4. **Response.** Based on the evaluation, response actions are started. Examples of typical actions are:

   - Rescue injured personnel
   - Control chemical hazards, if trained to do so
   - Evacuate

5. **Follow-up.** The entire emergency is reviewed prior to restarting work and adjustments are made to prevent another emergency.

First-Aid and Emergency Treatment

Plans for first aid should be in the overall medical program for the site. The physician should have ready access to the information about the chemicals on the site and the workers' medical histories. All first-aid personnel must be aware of the emergency response for heat stress problems. Drills should be held on a regular basis. In addition, at least one person on the site must be trained in first-aid procedures in case appropriate medical personnel and facilities are not available.

SECTION 6 - ASSIGNMENT SHEET

1. List ten minimum requirements for a site safety plan.

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2. List three work zones found on a hazardous waste site and explain the difference between them.

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3. List five major sections of an emergency response procedure.

_____

_____

_____

_____

_____

HAZARDOUS WASTE WORKER REFRESHER

Section

7

Title

MATERIAL HANDLING AND SAMPLING

TRAINEE OBJECTIVES

After completing Section 7, you will be able to:

1. Match the following words with the proper definition or example:

   Bulging drum
   Lab pack
   Overpack

2. List the two major ways that hazardous materials can be moved.

3. Give the Department of Labor recommended weight limit for objects that are regularly lifted.

4. Identify the two major categories of material sampling.

5. Name five indicators of possible contamination.

6. List the actions to take if a contamination source or indicator is found.

INTRODUCTION

Some of the most frequent and severe injuries associated with hazardous waste cleanup are those caused by material handling. Most injuries are the result of manually lifting and handling awkward or heavy objects. But even lightweight and small objects can injure the body when lifting involves bending, stretching, or moving body parts (fingers, arms, legs, or torso).

Whenever practical, always handle containers of unknown or unidentified waste with mechanical devices. When manual handling is required, always:

- Use proper work practices.
- Maintain a safe distance from other workers and hazard areas.
- Minimize handling of unknown materials until they can be identified.

HANDLING HAZARDOUS MATERIALS

The clean-up process involves handling hazardous materials and hazardous waste, which requires extra precautions because of the associated hazards. Because of the hazards associated with bulk containers, these materials are given priority with regards to clean up.

Figure 7-1 shows the typical steps that can be carried out when the handling of hazardous waste for disposal is part of the site cleanup.

Hazardous materials can be moved either manually or with mechanical devices such as front end loaders or cranes equipped with special attachments.

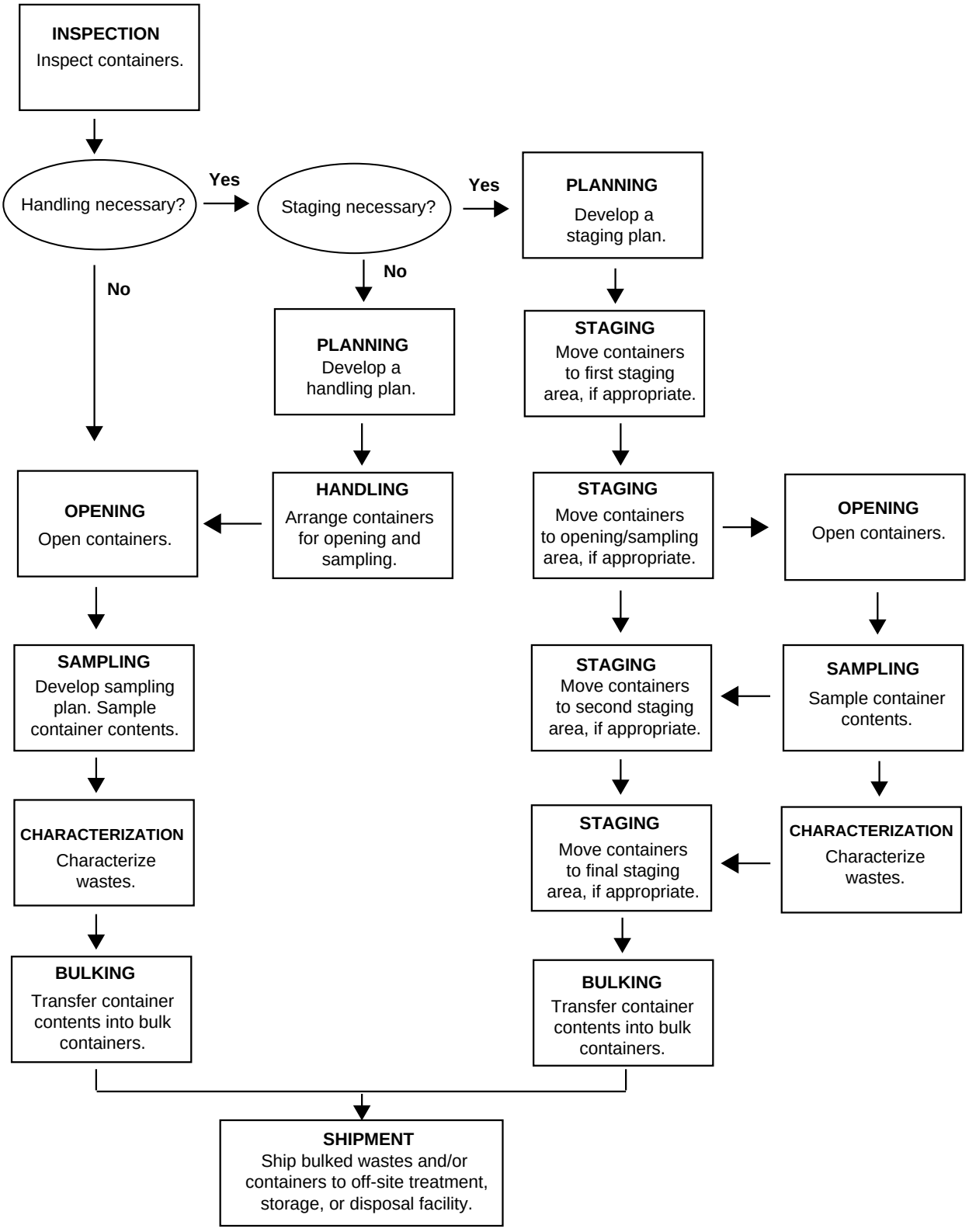

Figure 7-1. The material handling flow chart shows the typical steps in handling materials for disposal.

Mechanical Devices

Mechanical devices should always be used for lifting, moving, and opening waste containers whose contents are questionable or known to be unstable. They should also be used for lifting and moving objects that are too heavy or bulky for manual handling. Common mechanical material handling equipment includes:

- Fork lifts
- Cranes and hoists
- Backhoe, front end loader, etc.

Only workers who have been properly trained should be permitted to operate such devices.

Attachments

Two common attachments are work platforms and drum grapplers. Work platforms provide access to areas that would normally be difficult to reach or dangerous. A drum grappler is a device that allows remote drum handling.

Inspection

All mechanical lifting and moving devices must be inspected periodically and repaired when necessary. Under no circumstances shall defective equipment be used.

Manual Handling

When manually lifting and handling material, use only those methods that ensure worker safety and avoid damaging material or equipment being handled. Never attempt to lift objects that are either too heavy or bulky to handle safely. Whenever possible, push rather than pull loads. Pushing uses the strong leg muscles, whereas pulling uses the easily strained back muscles.

Weight Limits

There are no legal maximum weight limits for manual lifts. However, the Department of Labor recommends a 50-pound (23-*kg*) limit for objects regularly lifted. Under no circumstances shall an individual push or pull a load that exceeds 600 pounds (275 kg). Tasks that require frequent lifting of heavy objects should only be performed by workers who have been properly trained and are physically qualified.

HANDLING SPECIFIC CONTAINERS

The primary purpose of handling waste containers is to first identify or characterize the contents. Once the material is identified, the containers can be further handled to organize them into groups.

Visual Inspection

Conduct a visual inspection before physically handling any container. This inspection provides you with a preliminary classification for the containers. The classification determines the appropriate procedure to be used in handling each different class (type) of container.

Also the inspection results can be used to classify the container into groups of the same type.

Planning

Every step of a material handling operation should be carefully planned.

Radioactive Materials

If a container has labels or markings indicating that ionizing radiation is present, immediately signal for an area evacuation and contact the safety and health officer (S&HO). Do not handle any containers that may contain radioactive material until trained personnel survey the area and evaluate the situation.

Explosive or Shock-Sensitive Waste

If a container is suspected of containing explosive or shock-sensitive waste as determined by visual inspection, contact the S&HO before any handling.

Bulging Drums

A bulging or swelling drum can indicate that the drum is under pressure. This situation is extremely hazardous. Whenever possible, do not move drums that are bulging or swelling.

If a drum under pressure has to be moved, handle the drum with a grappler unit constructed for explosive containment. Move the bulged drum only as far as necessary to carefully overpack the drum.

Laboratory Packs

Laboratory packs are drums containing individual containers of laboratory materials normally surrounded by cushioning and absorbent material. Such containers should be considered explosive or shock-sensitive wastes until otherwise identified.

Leaking, Open, or Deteriorated Drums

Sometimes drums filled with liquids cannot be moved because they can break open. In this situation, transfer the liquid to another drum using a pump designed for moving the specific liquid.

Overpacking

Overpack drums are made to hold damaged drums or containers. The most common size is the 85-gallon overpack drum designed to hold a 55-gallon drum (Figure 7-2).

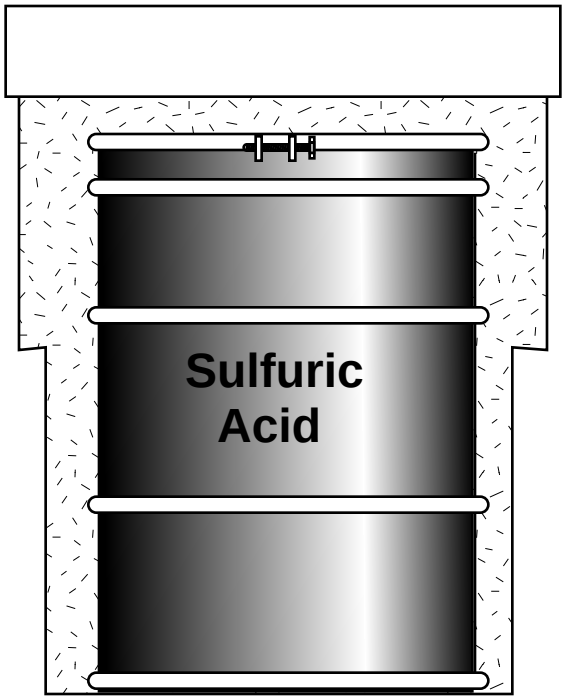

Figure 7-2. Overpack drums hold damaged drums or containers.

Note: Be sure the material being placed in an overpack drum is compatible with the overpack drum. For example, a corrosive material placed in a metal overpack drum will corrode the drum.

Drum Repair

Sometimes, a damaged drum can be repaired. But it must be determined that the drum is structurally sound, and there is no risk of leaking.

Buried Drums

At some sites, drums or containers may be buried and will have to be uncovered before they can be sampled or handled. Take special precautions when excavating drums.

Characterization

Characterization is required for all waste containers. In addition, routine samples of soil, water, and air are required to ensure that chemical contaminants are maintained below regulatory limits.

Data collected from characterization is used to determine how to safely and efficiently package and transport hazardous wastes for treatment or disposal. When *bulking* is used, wastes must be sufficiently characterized to determine if they can be safely combined.

When possible, materials should be characterized using an on-site laboratory. The advantages of using an on-site laboratory are:

- Provides data as rapidly as possible
- Reduces the time before action can be taken to handle hazardous materials

SAMPLING FOR LABORATORY ANALYSIS

Laboratory analysis consists of analyzing a field sample for chemical composition or contaminants under controlled conditions. It is required when the chemical composition of a material is incomplete or unknown. Material sampling is a part of the laboratory analysis. There are two primary categories of material sampling:

1. Bulk samples for solids and liquids
2. Wipe samples on surfaces

Each category has many types of sampling methods and techniques that can be used to collect samples. Most sampling activities are done by trained technicians.

Bulk Sampling

Bulk sampling refers to the collection and analysis of solid, liquid, or gaseous materials. The primary purpose of bulk sampling is to identify and measure chemical contaminants. It is also used to develop baseline information to characterize the existing status of the site and document compliance during cleanup. This information is then used to aid in the development of the Site Safety and Health Program.

Sampling Strategy

Collecting bulk samples can be dangerous to your health and safety. You often have direct contact with unknown wastes. The sampling plan will have valuable information to help keep you safe. Therefore review the sampling plan before collecting any sample.

Sampling Equipment

The type of equipment used to collect a bulk sample depends on the physical state of the material, its location, and the frequency with which samples are required.

Liquid Samples

Collecting liquid samples from containers can be dangerous because you often have direct contact with unknown wastes. Before collecting any sample, review the sampling plan.

Miscellaneous Sampling

It may be necessary to sample other types of containers and locations, such as:

- Tank trucks
- Elevated tanks
- Compressed gas cylinders
- Ponds and lagoons

Each of these situations is unique. Each presents its own set of hazards that needs to be identified in the sampling plan.

Surface Samples

Surface samples are collected by wiping a surface that is potentially or suspected to be contaminated with a chemical or biological agent. Surface contamination can be a significant source of external exposure through skin contact. It can be an internal hazard when it becomes airborne and is inhaled, or if it is ingested because of skin contamination.

SURFACE CONTAMINATION

Surface contamination is either fixed or removable.

- Fixed contamination – Contamination that cannot be easily removed from surfaces, such as by casual contact.
- Removable/transferable contamination – Contamination that can be removed from surfaces.

Indicators of Possible Contamination

Possible clues or signs that indicate the presence of contamination include:

- Airborne monitor alarm sounds
- Damaged containers
- Dusty, hazy air
- Higher than normal background readings on monitoring equipment
- Unexplained worker contaminations at exit points

Sources of Contamination

Contamination occurs when a hazardous material is spread to an unwanted location. The following conditions are sources of contamination:

- Leaks or breaks in containers or systems.
- Opening containers or systems without proper controls.
- Airborne contamination deposited on surfaces.
- Poor housekeeping practices in contaminated areas.
- Excessive motion or movement in areas of higher contamination.
- Sloppy work practices that result in cross-contamination of tools, equipment, or workers.

Response to Contamination Indicators

If you recognize unidentified contamination sources or indicators, follow these guidelines:

- Secure the work area
- Notify your co-workers of the situation
- Isolate the source, if possible, and leave the area
- Notify your supervisor

MATERIAL STORAGE

Every attempt should be made to minimize drum handling. However, sometimes drums must be staged or moved in an organized manner to predesignated areas. Staging helps characterization and cleanup. It also protects drums from potentially hazardous site conditions, such as movement of heavy equipment, extreme temperatures, or sunlight. Any of these conditions might cause an explosion, ignition, or pressure buildup.

Storage Practices

Use the following practices when storing hazardous materials:

- Labeling
- Securing
- Storing according to compatibility

Labeling

When preparing hazardous materials for shipping, labels must comply with the following:

- Standard procedures developed for a particular site
- Department of Transportation (DOT) regulations
- International Civil Aviation Organization (ICAO) regulations

Site specific labeling procedures usually require that labels include the following information:

- Location from which material was obtained
- Identification number
- Potential or known hazards

Securing

Once materials are properly labeled, they can be stored on site in any area that is secured against unauthorized personnel. This requirement protects those who are unaware of the hazards associated with the stored materials. It also protects materials from being tampered with or damaged by vandals.

Storing According to Compatibility

The storage area must be compatible with the materials being stored so that conditions within the storage area do not affect the materials in an adverse way.

In addition, materials stored together in an area should be *compatible* as a group. Never store incompatible materials in the same storage area unless the materials are separated by appropriate berms, dikes, or structures such as walls. Incompatible materials must be separated and stored on racks or stacked in appropriate stable piles. To prevent earthquake damage, secure the racks with tiedowns.

Storage Facilities

Materials to be stored shall not exceed either the rated floor capacity for the area or the weight capacity of the storage racks. The load limit and maximum height to which materials can be stacked shall be posted in a conspicuous location. Traffic lanes and loading areas shall be marked appropriately and kept clear. Floors in these areas shall be maintained in good condition at all times.

Figure 7-3 shows a typical staging arrangement. The number of staging areas needed depends on site-specific circumstances.

Bulking

Wastes that have been identified as compatible are often mixed together and placed in bulk containers. This practice is called bulking. Bulking is performed at the final staging area.

TRANSPORTATION

Once materials have been properly classified, packaged, and labeled, they can be prepared for transport. Personnel responsible for shipment of hazardous materials should ensure that proper classification, packaging, and labeling procedures have been followed. The shipper must then fill out the shipping papers according to the appropriate regulations (normally the DOT and state).

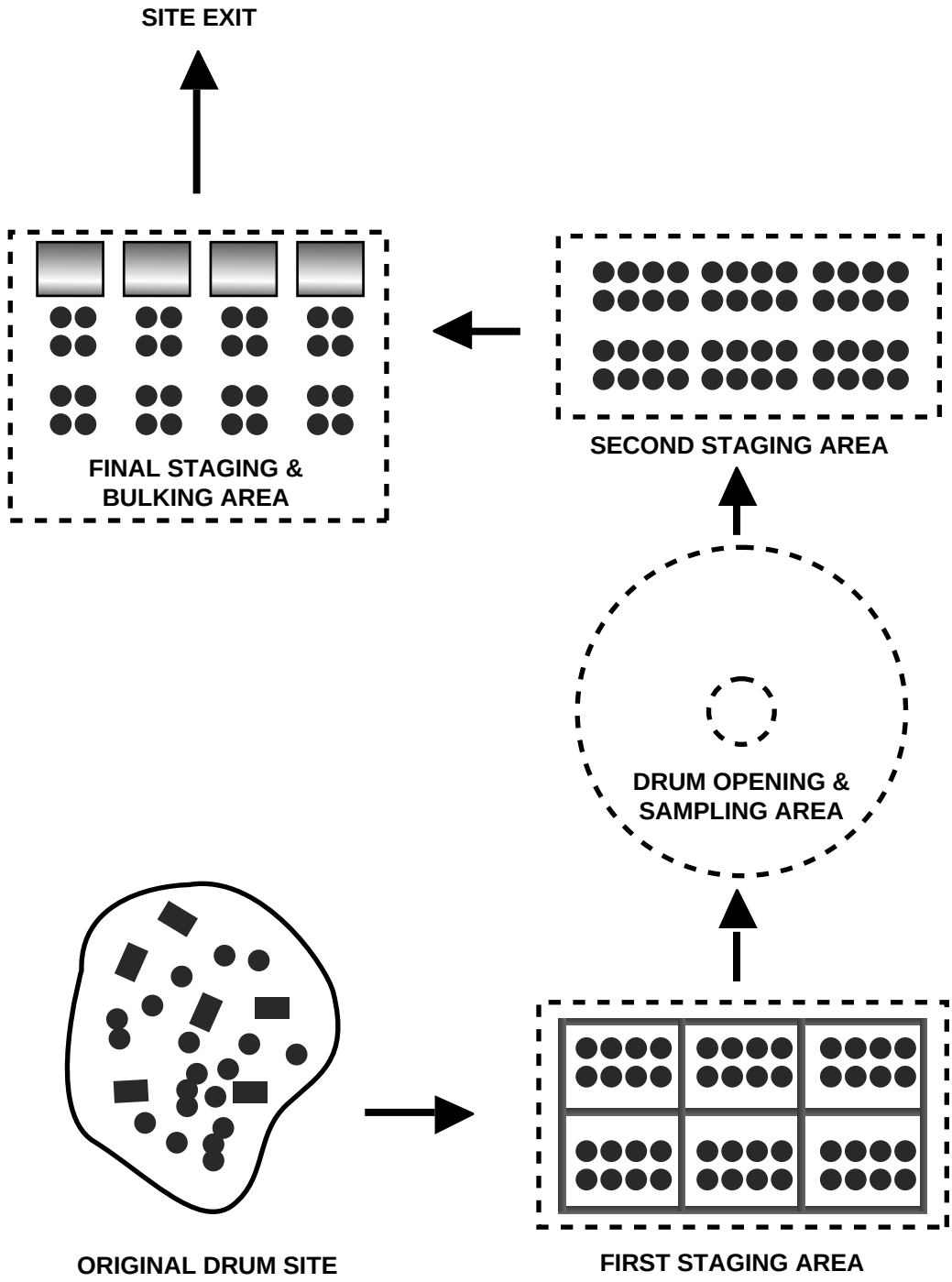

Figure 7-3. The staging arrangement will depend on site-specific circumstances.

SECTION 7 - ASSIGNMENT SHEET

1. Match the following words with the proper definition or example:

_____	Bulging drum	a. Container for holding damaged drums or containers.
_____	Lab pack	b. Drums that are under pressure.
_____	Overpack	c. Drums containing individual containers of lab materials.

2. List the two major ways that hazardous materials can be moved.

_____

_____

3. Give the Department of Labor recommended weight limit for objects that are regularly lifted

_____

_____

4. Identify the two major categories of material sampling.

_____

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5. Name five indicators of possible contamination.

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6. List the actions to take if a contamination source or indicator is found.

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HAZARDOUS WASTE WORKER REFRESHER

Section

8

Title

WORKPLACE MONITORING

TRAINEE OBJECTIVES

After completing Section 8, you will be able to:

1. List the two principle approaches for identifying and/or measuring chemical, physical, and biological hazards.

2. List five reasons for conducting workplace monitoring.

3. List the situations when workplace monitoring is required.

4. Identify five hazards that may need to be identified and evaluated under the workplace monitoring program.

5. Identify the three major categories of direct reading instruments.

6. Identify six limitations or factors that can affect an instrument's ability to detect hazards.

7. State the appropriate response to an equipment failure.

8. List five reasons for conducting laboratory analysis of workplace samples.

INTRODUCTION

Workplace monitoring is an ongoing process that begins during site characterization and continues to the end of the clean-up project. The information gathered from observations, research, analysis, and real-time monitoring is used to develop a site safety and health program. The Site Safety and Health Program outlines the workplace monitoring requirements, which are:

- Frequency and types of air and personnel monitoring.
- Environmental sampling techniques and instrumentation.
- Maintenance and calibration methods for monitoring and sampling equipment.

WORKPLACE MONITORING

Workplace monitoring is the process of collecting, detecting, and measuring the workplace for chemical, physical, and biological hazards. The main objective is to ensure that exposures stay below regulatory limits.

The two principle approaches for identifying and/or measuring these hazards are:

1. Direct reading instruments (*DRI*)
2. Laboratory analysis of workplace samples

Reasons for Workplace Monitoring

Workplace monitoring provides the necessary information for making decisions about worker health and safety. Reasons for conducting workplace monitoring include:

- Identify hazards.
- Evaluate the effectiveness of engineering controls and work practices.
- Assess worker exposures to chemical, physical, and biological agents.
- Determine compliance with occupational and environmental regulations.

- Locate and evaluate potential sources of contamination (poor work practices, faulty engineering controls, etc.).
- Determine the level of worker protection needed.
- Evaluate uncertain exposures.
- Identify the need for further sampling requirements.

When Workplace Monitoring is Required

Workplace monitoring is required in the following situations:

- During initial entry when the site evaluation shows the potential for ionizing radiation and/or immediately dangerous to life or health (*IDLH*) conditions.
- When chemical exposures above the permissible exposure limits (*PEL*s) are suspected.
- When airborne concentrations of contaminants are suspected to exceed the protection factors of the personal protective equipment (*PPE*) in use.
- When flammable or oxygen-deficient environments are suspected.
- When entering or working in permit-required confined spaces.
- During an emergency response.

Types of Hazards

Health and safety hazards are assessed under the workplace monitoring program, including those introduced by remediation technologies and equipment. This assessment includes the following common hazards:

- *Toxic chemicals* – Characterized by the presence of vapors, gases, and aerosols that have an adverse health effect on the human body.
- *Oxygen deficient atmosphere* – An atmosphere containing less than 19.5 percent oxygen.

- *Flammable atmospheres* – Presence of ignitable or explosive vapors, gases, aerosols, or dusts.

- *Corrosive chemicals* – Materials that cause severe irritation and destruction upon contact with human tissue.

- Total and respirable dust – Inert materials suspended in the air.

- Noise – Energy in the form of sound waves that damages the ears and causes hearing loss.

- Temperature extremes – Hot or cold temperatures that put extreme stress on the human body.

- Biological agents – Microscopic living organisms that have adverse health effects on the human body.

- Ionizing radiation – High energy in the form of waves or particles that have the ability to cause cellular damage in the human body.

DIRECT READING INSTRUMENTS

Direct reading instruments (*DRIs*) are usually small compact devices used to detect and measure airborne contaminants and energies, such as radiation and noise. The use of DRIs offers the following advantages:

- Provides information at the time of sampling
- Allows for rapid decision-making
- Responds to a broad category of chemical and physical hazards.

Types of Direct Reading Instruments

Many types of DRIs are used to monitor workplace conditions. The type of DRI used during hazardous waste operations depends upon the following:

- Hazards being monitored (noise, radiation, chemicals)
- Physical states of the material being monitored (gas, liquid, solid)
- Purpose of monitoring

The three categories of DRIs are:

1. Portable DRIs
2. Personal monitoring devices
3. Fixed (stationary) monitoring devices

Limitations

Before wearing or using a DRI, you should understand how the following factors affect the accuracy and reliability of its readings:

- Proper operation
- Calibration and checks
- Detection range
- Response time
- Interference
- Environmental conditions

PORTABLE DIRECT READING INSTRUMENTS

Some of the more common types of portable instruments include:

- Combustible gas/oxygen indicator
- Flame ionization detector
- Photoionization detector
- Radiation detector
- Detector tube
- Sound level meter

Combustible Gas and Oxygen Indicator

The combustible gas and oxygen indicator (*CG/OI*) is a dual purpose instrument that detects and measures areas for combustible gases and oxygen concentration.

CG/OIs are intended for use in normal atmospheres. They are not to be used in atmospheres that are oxygen enriched or oxygen deficient. Oxygen concentrations significantly lower or higher than that of normal air can cause incorrect readings.

Flame Ionization Detector

The *flame ionization detector* (*FID*) is a portable DRI used to detect organic compounds. It is a type of organic vapor analyzer (*OVA*). (*Organic compounds* are chemical compounds containing carbon, such as toluene and benzene.)

An FID operates in two modes:

1. Survey mode – Detects the total concentration of contaminants in the tested atmosphere.

2. Gas chromatograph (*GC*) mode – Detects and measures individual components (i.e., benzene, xylene, toluene), with detection limits as low as a few parts per billion (*ppb*).

Photoionization Detector

Another type of OVA is the *photoionization detector* (*PID*), a portable instrument used to detect many organic and a few inorganic gases and vapors. The primary use of a photoionization detector is identical to that of the FID. However, the PID is easier to use, costs less, and has a faster response time. A PID is designed for trace gas analysis in normal air.

Radiation Detector

The Geiger-Mueller counter is the most widely used and versatile type of portable radiation detection device. Also called a geiger counter, it is one of the most useful tools for screening low level radiation and radioactive contamination.

Geiger counters can be used to:

- Monitor contamination (hand-held).

- Locate and evaluate potential sources of radioactive contamination.

- Determine the level of worker protection and posting requirements.

- Identify the need for further sampling.

Detector Tube

A colormetric detector tube is capable of measuring the concentrations of a wide variety of compounds. A pump is used to draw a known volume of air through the detector tube. The chemical concentration is determined from the color change in the tube. This color change is the result of a chemical reaction between the chemical in the detector tube and the contaminant.

Detector tubes can be used to:

- Screen for specific organic and inorganic gases and vapors
- Detect leaks

Sound Level Meter

A sound level meter is a DRI that measures the intensity of sound at only one point in time. It is usually necessary to take a number of measurements, several times during the day, to estimate noise exposure over a workday. If noise levels fluctuate, the amount of time that noise remains at each of the various measured levels must be determined.

PERSONAL MONITORING DEVICES

Personal monitoring devices are small compact DRIs used to measure exposure to certain types of physical or chemical agents. These devices work on the same principles as portable DRIs, except they are much smaller and are carried on the body.

Employee's Responsibilities

If you are selected to wear a personal monitoring device:

- Wear the device as instructed
- Do not tamper with or remove the device during the monitoring period

Response to Equipment Failure

Follow these general steps when dealing with a failed personal monitoring device:

1. Secure the work area
2. Notify your co-workers of the situation
3. Exit to a safe area
4. Notify your supervisor or S&HO

The site safety and health plan will have specific information for you to follow regarding a personal monitoring device failure. Therefore, it is important for you to find out the appropriate response for your work site.

FIXED MONITORING EQUIPMENT

Fixed monitoring systems are fixed devices placed in locations where a chemical release or hazardous condition can develop and where the condition can be detected quickly. The main purpose of these instruments is to provide an early warning so workers can exit the area safely.

Emergency Alarms and Responses

Some sites have fixed monitoring systems strategically placed throughout the workplace. These systems provide audible and/or visual signals when an abnormal or hazardous condition develops. For your safety, it is essential that you:

- Know the location of the monitoring equipment
- Are able to identify the alarm signals
- Follow the correct emergency response

LABORATORY ANALYSIS

Laboratory analysis consists of collecting an environmental sample and analyzing it for chemical contaminants under controlled conditions.

Reasons for Laboratory Analysis

Laboratory analysis is required in the following situations:

- When extremely low concentrations of chemicals are present, and they cannot be adequately assessed using DRIs.
- When the chemical contaminant is in the form of a solid or mist that cannot be assessed using DRIs.
- When worker exposure to chemical or physical hazards needs to be measured over an extended period of time (such as a work shift) or when special maintenance work is required.
- To assist in determining the type and frequency of bioassay measurements needed for workers.
- To provide an estimate of worker exposures for situations where bioassay measurements may not be available or their validity is questionable.

AIR SAMPLES

Air samples are used for evaluating worker exposure to low concentrations of airborne contamination. An air sampling pump is the most commonly used device for sampling workplace atmospheric conditions and occupational exposures.

Air Sample Devices

Air sample devices are usually categorized as one of the following:

- Fixed-location
- Portable
- Personal

Selection of air sampling equipment is based on the type of sample being collected. The two main types are:

1. Area sample – Involves placing the collection devices within designated areas and operating them over specific periods of time. Area sampling is not a direct measurement of employee exposure.

2. Personal sample – Involves directly connecting a monitoring or sampling device to a worker, usually within the breathing zone. The device will collect a sample and/or record the intensity of an agent (i.e., noise, ionizing radiation) as the worker moves from place to place.

Sampling Strategy

In areas where you are likely to exceed occupational exposure limits, breathing zone air monitoring should be performed continuously during occupancy. Integrated or continuous monitoring collects and records samples or measurements over a specific length of time, usually a work shift. Sample analysis provides an average level of a specific agent for the shift. This is important because many chemical and physical hazards are based on 8-hour exposure periods. A combination of both direct-reading and time-integrated sampling is performed to get a complete picture of workplace exposure and emission sources.

Response to Air Sampler Failure

Notify your supervisor if you find a broken air sampler during work activities.

If your personal sampling pump fails, you should:

- Secure the work area
- Notify your co-workers of the situation
- Exit
- Notify your supervisor or S&HO

SECTION 8 - ASSIGNMENT SHEET

1. List the two principle approaches for identifying and/or measuring chemical, physical, and biological hazards.

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2. List five reasons for conducting workplace monitoring.

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3. List the situations when workplace monitoring is required.

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4. Identify five hazards that may need to be identified and evaluated under the workplace monitoring program.

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5. Identify the three major categories of direct reading instruments.

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6. Identify six limitations or factors that can affect an instrument's ability to detect hazards.

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_____

7. State the appropriate response to an equipment failure.

_____

_____

_____

_____

8. List five reasons for conducting laboratory analysis of workplace samples.

_____

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HAZARDOUS WASTE WORKER REFRESHER

Section

9

Title

PERMIT-REQUIRED CONFINED SPACE

TRAINEE OBJECTIVES

After completing Section 9, you will be able to:

1. Define a confined space.
2. Define a permit-required confined space.
3. Identify potential physical and atmospheric hazards in confined spaces.
4. List the three tests performed during pre-entry testing, in their proper order.
5. Identify when the air inside a confined space must be continuously monitored or regularly retested.
6. Identify the two basic categories of ventilation.
7. List the nine minimum requirements of a confined space program.
8. List the 15 required elements of a confined space entry permit.
9. List recordkeeping requirements for canceled permits.
10. Identify the four members of a confined space team.
11. Describe the procedures used in isolation.

CONFINED SPACE

According to the Occupational Safety and Health Administration (*OSHA*), a *confined space* is any area with the following characteristics:

- Adequate size and shape to allow a person to enter
- Limited openings for workers to enter and exit
- Not designed for continuous human occupancy

Each year, more than 5,000 workers sustain serious injuries while entering or working in confined spaces. In addition, more than 300 workers die in confined-space accidents annually. Of those workers killed, 60 percent are would-be rescuers. Figure 9-1 shows the breakdown of confined space fatalities by cause.

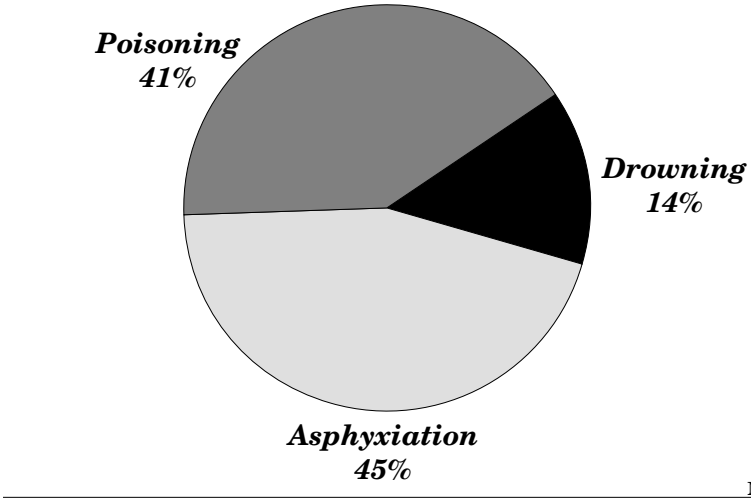

Figure 9-1. This chart illustrates the causes of confined space fatalities from 1983 to 1993.

There are two major factors that lead to fatal injuries in confined spaces:

1. Failure to recognize and control the hazards associated with confined spaces such as:

   - Asphyxiation
   - Electrical shock
   - Engulfment
   - Falls
   - Heat stress

2. Inadequate or incorrect emergency response - Without a predetermined emergency plan, workers usually react impulsively to an emergency. This situation can result in rescuers as well as victims being hurt or killed.

Entry into a confined space occurs when any part of a body breaks the plane of an opening. For example, just putting your head inside a confined space to look around is considered an entry.

PERMIT-REQUIRED CONFINED SPACE

OSHA further defines confined space through its Permit-required Confined Space Entry Standard (29 *CFR* 1910.146). This standard protects you from the hazards associated with confined space entry operations. It requires employers to:

1. Evaluate the workplace
2. Determine if any spaces are permit-required confined spaces
3. Inform and train workers

Any space that is not classified as a confined space or *permit-required confined space* shall not be entered until it is classified. Do not assume that because a space is unmarked, it is safe to enter.

A permit-required confined space is a confined space with one or more of the following characteristics:

- Contains, or has the potential to contain, a hazardous atmosphere. This atmosphere can be caused by chemicals that have been stored in the space or activities that are taking place in the space. These activities include welding, cutting, or using cleaning solvents.

- Contains a material that has the potential for engulfing the entrant (worker entering the confined space). These materials could be granular (grains or sands) or sludges.

- Internal configuration (shape) is such that an entrant could be trapped or asphyxiated by inwardly

converging walls or by a floor that slopes downward to a smaller cross-section. A good example is a grain bin in which the space is shaped like a funnel.

- Contains any other recognized serious hazard. Examples include confined spaces with moving or electrical parts.

A hazard is any condition, situation, or agent that has the potential to produce an undesirable effect. Hazards found in a confined space can be caused by any of the following:

- Materials being stored or used in the space
- Processes taking place inside the space
- Effects of the external environment on the space

These hazards are divided into two basic categories—hazardous atmospheres and physical hazards.

ATMOSPHERIC HAZARDS

Hazardous atmospheres cause the most deaths and injuries in confined spaces. OSHA divides atmospheric hazards into three categories:

- Oxygen deficient and oxygen enriched
- Flammable and explosive
- Toxic

Oxygen-Deficient and Oxygen-Enriched

OSHA defines an *oxygen-deficient atmosphere* as one containing less than 19.5 percent oxygen by volume. Oxygen-deficient atmospheres are dangerous because asphyxiation can occur when the oxygen content drops below normal (approximately 21 percent). This type of atmosphere can result from chemical reactions (combustion/decomposition) and from microscopic living organisms that consume oxygen. Examples of work activities that consume oxygen are welding, cutting, or brazing.

An atmosphere containing more than 23.5 percent oxygen is classified as an *oxygen-enriched atmosphere*. This type of atmosphere presents a serious fire hazard. The high level of oxygen causes flammable and combustible materials to burn more violently when ignited.

Flammable and Explosive

Flammable or explosive atmospheres are characterized by the presence of ignitable or explosive vapors, gases, aerosols, or dusts at a concentration greater than 10 percent of their lower explosive limit (LEL). For a flammable or explosive atmosphere to exist, the following elements must be present, in the correct proportions:

- Fuel
- Oxygen
- Heat

Toxic

Toxic atmospheres are characterized by the presence of chemical or biological agents that have an adverse health effect on the human body. OSHA defines a toxic atmosphere as any atmosphere having a chemical or biological agent in excess of its permissible exposure limit (*PEL*). Toxic materials are of greater concern when they are in the gaseous state because they can be inhaled.

TESTING FOR ATMOSPHERIC HAZARDS

To ensure worker safety, two types of atmospheric testing are conducted in a confined space:

- Pre-entry testing
- Periodic testing and/or continuous monitoring

Pre-Entry Testing

Pre-entry atmospheric testing is necessary for safe entry into a confined space. It shall be performed from the outside of the confined space using remote probes and sampling lines. There are three tests used to identify hazardous conditions in a confined space. They should be performed in the following order and include:

1. Oxygen level test
2. Flammability test
3. Toxic air contaminants test

It is extremely important that the top, middle, and bottom areas are tested. Vapors and gases have different vapor densities and will behave differently:

- Normal air has a vapor density value of 1.
- Gases and vapors that have a vapor density value greater than 1 will initially settle to the bottom of a confined space.
- Gases and vapors that have a vapor density value of less than 1 will collect around the top of a confined space.

If testing reveals an unsafe atmosphere, the space must be ventilated and retested before entrants enter. If *ventilation* is not possible and entry is necessary (i.e., emergency rescue), entrants must be provided with the appropriate respiratory protection.

Oxygen Level Test

The first pre-entry test is the oxygen level test. Many combustible gas/oxygen indicator (*CG/OI)* meters cannot measure for flammability when oxygen concentrations drop below 10 percent. For safe entry, the oxygen level must be between 19.5 percent and 23.5 percent.

Flammability Test

Measuring for flammability in a confined space is performed after the oxygen level is determined.

Always assume air in a confined space is hazardous when the concentration of the flammable gas, vapor, or mist exceeds 10 percent of the lower flammable limit *(LFL*). It is also flammable when the concentration of airborne combustible dust meets or exceeds its LFL. After entry, if tests indicate that the atmosphere could or has become flammable, all equipment must be shut off immediately and the confined space evacuated until it is safe.

Toxic Air Contaminant Test

The third test measures the level of toxic air contaminants. If the concentration of any toxic substance exceeds OSHA's PEL, the atmosphere in the space is considered hazardous. The entry permit must list the toxic materials to test for and the PEL for each substance.

Periodic Testing and Continuous Monitoring

Periodic testing and continuous monitoring are necessary to ensure the air inside a confined space remains safe while entrants are inside. Immediately after entering a confined space, the air shall be retested for oxygen level, flammability, and toxicity.

The air inside a confined space must be monitored continuously, or retested regularly, for as long as anyone is inside the confined space. The entry permit will note whether continuous monitoring is needed or how often the air shall be retested.

Air monitoring sensors must be placed in the appropriate locations to perform accurate continuous monitoring. When an air monitoring alarm sounds, you shall leave the confined space immediately. The alarm indicates the air has changed and can be approaching a hazardous condition. The hazard must be brought under control and the air retested before entrants re-enter the space.

CONTROLLING HAZARDOUS ATMOSPHERES

Most atmospheric hazards can be controlled through the use of proper ventilation. Ventilation is the continuous movement of fresh, uncontaminated air throughout a confined space to eliminate or reduce atmospheric hazards. Fans, blowers, or natural movement are used to move the fresh air.

Toxic and Oxygen-Deficient Atmospheres

Ventilation is the preferred method for controlling a toxic atmosphere in a confined space. Fresh air is brought into the confined space to dilute the concentration of contaminants to a safe level for entrants. If work activities within the confined space are causing a toxic atmosphere, ventilation can reduce the concentration of contaminants to an acceptable level.

Ventilation is also used when the air inside a confined space is oxygen deficient. The act of pushing uncontaminated air into the space increases the oxygen level.

Flammable Atmospheres

Flammable atmospheres are prevented or controlled by either *purging* or *inerting* the confined space. Purging removes the fuel element of the fire triangle. Inerting removes the oxygen element of the fire triangle.

VENTILATION

Ventilating confined spaces is one of the best ways to control or reduce hazards, whether they are dangerous atmospheres or temperature extremes. The entry supervisor determines how a confined space will be ventilated. The procedures will then become a part of the *confined space permit*.

There are two basic categories of ventilation. They are referred to as *general ventilation* and *local exhaust*. General ventilation is the process of ventilating the entire space. Usually, fresh, uncontaminated air is used to weaken the concentration of contaminants within the confined space. General ventilation can also be used to cool entrants inside a confined space.

Local exhaust is a process that removes contaminants at the source from which they are generated. This process is common during cleaning operations using solvents inside the confined space. Vapor hoods are located just above the area where the solvent is being applied. The vapors are gathered quickly into the hood before they have the opportunity to spread throughout the confined space.

Supply and Exhaust Systems

By definition, ventilation means to "move air." There are two systems that are used to move air: *supply system* and *exhaust system*.

A supply system pushes fresh air into a confined space using blowers or natural air movement. An exhaust system pulls air from a confined space using fans or fume hoods.

The main difference between a supply system and an exhaust system is efficiency. Air can be pushed much farther than it can be pulled. More precisely, air can be pushed 30 feet but only exhausted (pulled) 1 foot. Supply systems have a 30:1 exhaust-to-capture ratio.

Mechanical Ventilation

Mechanical ventilation is the most common method of ventilation. It uses blowers or fans and ducts to ventilate a confined space. Even with the disadvantages, mechanical ventilation is still the preferred way to ventilate.

Natural Ventilation

In some work environments and with perfect weather conditions, natural air movement can be used to ventilate a space. However, the wind velocity and direction would have to be easily forecast. Usually natural ventilation is used to improve worker comfort and not to remove contaminants.

Planning Considerations

No matter which ventilation method is used, careful thought has to be given to all aspects of the confined space entry. The following should be considered:

- Previous contents
- Internal obstructions
- Existing openings
- Natural drafts
- *Vapor density*
- Operations in the space
- *Contaminant reentrainment*
- Short circuiting
- Portal obstructions

PHYSICAL HAZARDS

Confined spaces can also contain physical hazards associated with the following situations or conditions:

- Engulfment
- Temperature extremes
- Noise
- Mechanical, electrical, and hydraulic systems
- Falling objects
- Wet or slick surfaces

Engulfment

Engulfment in loose materials or liquid is one of the leading causes of death from physical hazards in confined spaces. Engulfment and suffocation are hazards associated with the following:

- Bins
- Hoppers
- Sewage treatment plants
- Silos
- Storage tanks

These spaces store, handle, or transfer liquids, grains, sand, gravel, or other loose materials.

The movement of such material is unpredictable. You can be trapped and buried or drowned in a matter of seconds. When a storage bin is emptied from the bottom, the flow of materials forms a funnel-shaped path over the outlet. As the material empties, it can cause the top surface to act like quicksand, causing unsuspecting workers on the top to be drawn into the material. During a normal unloading operation, the flow rate can be so great that once you are drawn into the flow path, escape is virtually impossible.

Temperature Extremes

Extreme temperatures within a confined space can affect your health and ability to safely perform your tasks. Knowing the signs and symptoms of heat stress and cold stress can help you prevent injury.

Noise

When working in a confined space, noise can be amplified and cause damage to the ear. It also can affect the health and safety of workers. It is important to remember to use hearing protection when noise levels exceed 85 dB.

Mechanical, Electrical, and Hydraulic Systems

During confined space work, it can be difficult to separate a worker from hazardous forms of energy, such as powered machinery, electrical energy, and hydraulic or pneumatic lines. Activation of electrical or mechanical equipment can cause injury or death to workers in a confined space.

Another concern with mechanical or hydraulic systems is the release of material through the lines. A release of material can engulf or drown workers. Isolation procedures prevent sudden releases of energy that can harm workers in a confined space. (Both isolation methods and procedures are discussed later in greater detail.)

Falling Objects

Falling objects are a potential threat in confined spaces, especially when spaces have topside openings. Tools and other objects can fall in and strike a worker. To prevent injury:

- Secure tools or materials on top of the confined space so they are not accidentally dropped into the space.
- **Never** drop materials into the space to workers. Always lower them down to prevent hitting someone.

Wet and Slick Surfaces

Wet or slick surfaces create slipping and tripping hazards. They can also provide a grounding path and increase the possibility of electrocution.

CONFINED SPACE ENTRY PROGRAM

OSHA requires employers to have a written permit-required confined space entry program. This program must establish procedures for controlling hazards associated with entry into permit spaces. It must include at least the following requirements:

- Confined space entry training for authorized entrants, attendants, supervisors, and rescue personnel.
- Documented compliance through a confined space entry permit.
- Entry supervisors and attendants to control and monitor entry operations.
- Evaluation and control of permit-required space hazards.
- Identification of all permit-required spaces in the work place.
- Permit-required entry procedures.
- Posted warning signs and appropriate barriers.
- Personal protective equipment (PPE) and rescue equipment for authorized entrants, attendants, and rescue personnel.
- Trained and available rescue team.

Confined Space Entry Permit

The OSHA Permit-Required Confined Space Standard requires employers to establish a confined space entry permit system. The confined space entry permit is a critical component of this system. It fulfills the following functions:

- Authorization form that must be completed prior to permit-required confined space entry.
- Explanation of the hazards in the confined space and how to control them.
- Primary source of information for the potentially hazardous atmospheres in the permit space.

The confined space entry permit must be:

- **Posted** at the entrance to the confined space for the length of the job.
- **Available** to authorized entrants so they can confirm that all pre-entry preparations have been made and appropriate PPE is being worn.
- **Retained** for at least one year after the expiration date to facilitate review of the permit-required confined space entry program. The review ensures that workers participating in entry operations are protected from permit space hazards.

The success of the permit in protecting workers comes from guiding the entry supervisor, entry attendant, and entrants through a systematic evaluation of the confined space to be entered. Although entry permits have many different formats, they all must contain the following basic information:

- Location of space to be entered
- Purpose of entry
- Date and authorized duration of the permit
- Authorized entrants
- Authorized attendants
- Name of entry supervisor
- Hazards in space
- Measures used to isolate space or control hazards

- Acceptable entry conditions
- Results of initial and periodic monitoring tests
- Rescue and emergency services
- Communication procedures
- Equipment needed, such as:
  - PPE
  - Alarm systems
  - Testing, communications, and rescue equipment
- Any other necessary information
- Any additional permits issued

Confined Space Entry Team

Confined space work requires teamwork. Therefore, it is essential to designate a confined space entry team every time a worker enters a confined space. A confined space entry team comprises the following members:

- Entrant
- Attendant
- Entry supervisor
- Rescue personnel

The confined space entry team must always have at least two people—the attendant and entrant. However, either person can have more than one role. For example, the attendant can also be the entry supervisor. Many times a confined space entry team has three or more workers. The work performed inside the space can require more than one entrant, or two attendants may be needed.

Confined space entry teams are most effective when team members are:

- Confident of each others' abilities
- Cross-trained in all functions
- Knowledgeable of each others' responsibilities

Entrant

The *entrant* is the worker who actually enters the confined space to work. The principal responsibility of the entrant is to complete the job assignment safely and properly.

Attendant

The attendant is the worker who remains outside the confined space while the work is being done inside the space. The principal responsibility of the attendant is to make sure the entrant remains safe.

Sometimes the confined space permit program allows attendant entry for a rescue. Attendants can enter a permit space to attempt a rescue only if they have been:

- Trained and equipped for rescue operations
- Relieved by a trained attendant

Entry Supervisor

The *entry supervisor's* general responsibilities include:

- Determining if acceptable entry conditions are present at a permit space where entry is planned.
- Authorizing entry.
- Overseeing entry operations.
- Terminating entry as required by the regulations.

The entry supervisor can also be responsible for identifying confined spaces at a site.

Rescue Personnel

All members of a rescue team shall be provided with the equipment necessary for making rescues from a permit space. They shall also be trained in its proper use. This includes PPE, as well as any rescue equipment. Rescue team members must also know the duties and responsibilities of the entrants.

An employer can decide to use an outside rescue service, such as a fire department or a hazardous materials (HazMat) response team, for the rescue team. In this case, the rescue service must have all the necessary information to conduct a rescue at the facility, including the hazards that can be encountered. In addition, the rescue service should have access to all permit spaces to develop rescue plans and practice rescue operations.

To aid nonentry rescue, retrieval systems or other methods must be used whenever an authorized entrant enters a permit space. There are two exceptions. A retrieval system should not be used when it:

- Increases the overall risk of entry
- Does not contribute to the rescue of the entrant

RETRIEVAL SYSTEMS

Having an entrant attached to a tripod helps in a nonentry rescue. The tripod is used to retrieve an entrant during a rescue attempt where the victim needs to be evacuated from the space as quickly as possible.

A tripod should have at least two mechanisms, one for rescue and one for fall arrest. With new advances in equipment, most tripods have one mechanism that can be used both for rescue and fall protection. Winches should be self-braking to prevent a worker from free falling.

The ideal situation is to have the entrant wearing a full-body harness, with a main, lifesaving lanyard hooked to a D-ring on the back of the body, and a fall arrest lanyard hooked to the same D-ring. Having the two lanyards aids the egress procedure. The entrant is kept stable while being raised or lowered into the confined space. When using newer equipment with one mechanism for fall arrest and rescue, the lanyard is hooked to the back of the body.

ISOLATION

Isolation is the process by which a permit space is removed from service and completely protected against the release of energy and material into the space. An *energy-isolating device* prevents the release of energy or materials. Isolation procedures include:

- Lockout or tagout of all sources of energy
- *Blanking* or *blinding*
- Misaligning or removing sections of lines, pipes, or ducts
- Blocking or disconnecting all mechanical linkages

Employers use isolation procedures as their primary tool for protecting *entrants*. The confined space entry permit must list the isolating devices and procedures used.

Locking Out Energy and Material Devices

Many entrants have died when switches and valves were shut off, but not locked out. They were electrocuted, drowned, or mutilated. Tragically, there are times when lockout is not used because someone thinks it is too inconvenient. However, “one worker, one lock, one key” is a method that is safer than any OSHA standard.

Some confined spaces have many systems that need to be locked out. One space may have electrical lines, a pump, and sewage pipes that all have to be locked out. Proper procedures for lockout/tagout must be followed to safely isolate the confined space.

Lockout/Tagout Energy Control Procedures

An employer is required to implement a written lockout/tagout program when an entrant performs work on any machine or equipment that can unexpectedly release energy or materials and cause injury to the worker (29 CFR 1910.147). The lockout/tagout program lists the energy control procedure requirements. These requirements describe in detail the steps that must be taken to ensure that electrical devices are shut off at their power source.

Limitations of the Lockout Devices

If the energy-isolating device is lockable, the employer shall use locks unless it can be proved that tags would provide protection at least as effective as locks. When locks cannot be used, the employer must comply with the tagout provisions. Employers must provide training for workers in the limitations of tags.

Lockout/Tagout Device Requirements

The lockout/tagout device used must be identified in the written lockout/tagout program. Only the devices identified in the written program can be used for controlling hazardous energy. Additionally, all of the devices must meet the following requirements:

- Durable
- Standardized
- Substantial
- Identifiable

Blanking or Disconnecting Pipes and Process Lines

Many confined space entrants have been injured or killed when hazardous liquids and gases leaked into the work space through pipe connections. Proper training in a company's written isolation procedure is critical for preventing injuries and death.

Work processes used for isolating a pipe system after draining or depleting the line include:

- Disconnecting lines
- Blanking or blinding
- Double-block and bleed

Disconnecting Lines

Before a line can be disconnected, a competent person should review the material safety data sheets (*MSDS*s) for the hazardous substances in the line and surrounding area.

Pipelines are disconnected by removing the bolts from the flanges or by unwinding some of the threaded pipe sections. *First-break* is the term used for the initial disconnection or breaking of the pipeline. *Line breaking* is the term used for the intentional opening of a pipe, line, or duct that is or has been carrying materials.

Once a pipeline is disconnected, it can be misaligned to stop the flow of any hazardous material into the confined space.

Blanking or Blinding

Blanking or blinding is the absolute closure of a pipe, line, or duct. A solid plate, such as a spectacle blind or skillet blind, is fastened over the bore to completely cover it. The plate must be:

- Able to withstand the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.
- Compatible with the material in the line, duct, or pipe.

Otherwise, the plate could corrode or react with the material in the pipeline, causing additional hazards such as a leak or toxic fumes. The plate must fit perfectly between the flanges so the bolts can be tightened enough to prevent leakage and movement.

Double-Block and Bleed

Double-block and bleed is a three-valve system for closing off a pipe. The system uses a T-configuration. Two valves close off each end of a section of pipe. A third valve is located at the bottom of the pipe. Material left between the two end valves is drained out by opening the bottom valve.

SECTION 9 - ASSIGNMENT SHEET

1. Define a confined space.

2. Define a permit-required confined space.

3. Identify potential physical and atmospheric hazards in confined spaces.

4. List the three tests performed during pre-entry testing, in their proper order.

_____

_____

_____

5. Identify when the air inside a confined space must be continuously monitored or regularly retested.

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6. Identify the two basic categories of ventilation.

_____

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7. List the nine minimum requirements of a confined space program.

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8. List the 15 required elements of a confined space entry permit.

9. List recordkeeping requirements for canceled permits.

10. Identify the four members of a confined space team.

11. Describe the procedures used in isolation.

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HAZARDOUS WASTE WORKER REFRESHER

Section

10

Title

LEGAL RIGHTS

TRAINEE OBJECTIVES

After completing Section 10, you will be able to:

1. List 14 employee rights under the Occupational Safety and Health Act of 1970.

2. List the OSHA standards that contractors at Government-Owned Contractor-Operated (GOCO) facilities must comply with pursuant to DOE Order 5483.1A (6/22/83).

3. List the requirements for providing health and safety information to employees, and for ensuring contractor compliance with job safety and health rules under DOE Order No. 5483.1A.

4. List the minimum health and safety regulations for federal employees.

INTRODUCTION

As a hazardous waste worker, you must have a basic understanding of your legal rights, as well as the laws and regulations governing hazardous waste, in order to protect yourself in the workplace. The following section summarizes your rights as an employee.

OCCUPATIONAL SAFETY AND HEALTH ACT

The Occupational Safety and Health Act of 1970 (*OSH Act*) is the most significant labor-protective statute for health and safety in the workplace. The OSH Act encourages employers and employees to work together so that workplace hazards can be reduced. This act was created by Congress and is administered by the Occupational Safety and Health Administration (*OSHA*) within the Department of Labor (*DOL*).

OSHA Employee Workplace Rights

Under the OSH Act employees have the right to:

1. Review copies of appropriate standards, rules, regulations, and requirements that the employer should have available at the workplace.

2. Request information from the employer on safety and health hazards in the workplace, precautions that may be taken, and procedures to be followed if an employee is involved in an accident or is exposed to toxic substances.

3. Have access to relevant employee exposure and medical records.

4. Request the OSHA area director to conduct an inspection if they believe hazardous conditions or violations of standards exist in the workplace.

5. Have an authorized employee representative accompany the OSHA compliance officer during an inspection tour.

6. Respond to questions from the OSHA compliance officer, particularly if there is not an authorized employee representative accompanying the compliance officer on the inspection walk-around.

7. Observe any monitoring or measuring of hazardous materials and see the resulting records, as specified under the Act, and as required by OSHA standards.

8. Review or have an authorized representative review, the Log and Summary of Occupational Injuries (OSHA Form No. 200) at a reasonable time and in a reasonable manner.

9. Object to the abatement period set by OSHA for correcting a violation.

10. Be present during an informal conference the employer sets up by contacting or writing the OSHA area director within 15 working days from the date the employer receives the citation.

11. Submit a written request to the National Institute for Occupational Safety and Health (*NIOSH*) for information on whether any substance in the workplace has potentially toxic effects in the concentration being used, and have name withheld from employer, if requested.

12. Be notified by the employer if the employer applies for a variance from an OSHA standard, testifies at a variance hearing, and appeals the final decision.

13. Have names withheld from employer, upon request to OSHA, if a written and signed complaint is filed. Be advised of OSHA actions regarding a complaint and request an informal review of any decision not to inspect or issue a citation.

14. File a Section 11(c) discrimination complaint if punished for exercising the above rights or for refusing to work when faced with an imminent danger of death or serious injury and there is insufficient time for OSHA to inspect.

Right to Refuse Work - Imminent Danger

If you believe a situation may place you in imminent danger of serious injury or death, you may be able to refuse an assignment. If you refuse an assignment:

- Explain to the supervisor why you are refusing to work.
- Request an alternate assignment until the situation is corrected.

For example, assume you are scheduled to work in a Level A situation and discover that the valve in the *SCBA* is not working. You ask that it be repaired. However, the supervisor schedules you for a shift that will start before the repair crew will be able to check out and repair the SCBA. Can you refuse this assignment? What should you say to the supervisor? What else should you do?

You should first contact your Safety and Health Officer (*S&HO*), then your supervisor and Local Union Business Agent. They may wish to consider filing a complaint with OSHA.

In the example, the situation would be corrected once the equipment was repaired or if a properly working SCBA was provided.

Discrimination 11(c)

If you discover that you have been discriminated against, you should:

- Make a list of the facts.
- Contact OSHA in person, by letter, or by telephone within 30 days of the discovery. (There are no forms to fill out.)

OSHA Section 11(c) states that:

1. "No person shall discharge or in any manner discriminate against any employee because such employee has filed any complaint or instituted or caused to be instituted any proceeding under or related to this Act or has testified or is about to testify in any such proceeding or because of the exercise by such employee on behalf of himself or others of any right afforded by this Act.

2. Any employee who believes that he has been discharged or otherwise discriminated against by any person in violation of this subsection may, within thirty days after such violation occurs, file a complaint with the Secretary alleging such discrimination.

OSHA cannot protect you if you are disciplined solely for refusing to comply with OSHA regulations or valid health or safety rules established by your employer. If you want to protest discrimination or punishment that is not related to your OSHA rights, contact your union or the appropriate government agency or file a Section 405 reprisal complaint (under the Surface Transportation Assistance Act (*STAA*).

SPECIAL RULES FOR CONSTRUCTION

All individuals designated as competent persons are members of management with the authority to prevent and correct hazardous conditions.

Competent Person Responsibilities

To be in compliance with OSHA construction standards, every employer must designate competent persons to carry out the Site Safety and Health Program and to supervise, inspect, or perform work as specified in the standards subparts.

Under the Job Site Safety and Health Program, a competent person has the following responsibilities:

- Prohibit use of any machinery, tool, material, or equipment not in compliance with safety standards.
- Identify, lock controls, or remove all machines, tools, materials, or equipment from the job site that do not comply with safety standards.
- Allow only those employees qualified by training or experience to operate equipment and machinery.
- Instruct employees in the recognition and avoidance of unsafe conditions.
- Instruct employees in safety and health regulations applicable to their work.

TRAINING REQUIREMENTS

All employees exposed to hazardous substances, health hazards, or safety hazards shall be thoroughly trained according to 29 CFR 1910.120, in the following:

1. Use of personal protective equipment.
2. Work practices by which the employee can minimize risks from hazards.
3. Safe use of engineering controls and site equipment.
4. Names of personnel and alternates responsible for site safety and health.
5. Safety, health, and other hazards present on the site.
6. Employees who may be exposed to unique or special hazards shall be provided additional training. All employees shall also receive a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor.

Training Hours

All employees shall at the time of job assignment receive a minimum of 40 hours of initial instruction off site. The level of training provided shall be consistent with the employee's job function and responsibilities.

Certification

Employees shall not participate in field activities until they have been trained to a level required by their job function and responsibility. Courses must be taught by competent instructors and updated as new information becomes available.

MEDICAL SURVEILLANCE REQUIREMENTS

The OSHA standard requires an employer to institute a medical surveillance program. Requirements under the program include the following:

1. Employees are required to undergo certain medical examinations.
2. Employers must take certain medical steps to protect workers.
3. Employees have rights to medical records under 29 CFR 1910.20 "Access to employee exposure and medical records."

Medical surveillance requirements include recognition of signs and symptoms that might indicate overexposure to hazards.

Frequency of Medical Examinations

The following list outlines the frequency of medical examinations and consultations:

- Prior to employment.
- Once every 12 months after employment.
- At termination of employment.
- If reassigned to an area that is not covered by the Standard and the employee's last exam was more than six months ago.
- If exposed—as soon as possible upon notification by an employee that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards.
- Immediately for an unprotected employee who has been exposed in an emergency situation.

NATIONAL LABOR RELATIONS BOARD

You may be protected by the National Labor Relations Board (*NLRB*), if you refuse dangerous work in cooperation with other workers.

OSHA and the NLRB cooperate in refusal-to-work cases involving health or safety hazards. You may contact OSHA or NLRB to discuss your case.

The following is a small portion of the National Labor Relations Act (Section 7):

> . . .nor shall the quitting of labor by an employee or employees in good faith because of abnormally dangerous conditions for work at the place of employment of such employee or employees be deemed a strike under this chapter.

UNION ROLE IN PROTECTING RIGHTS

The role of the union is governed largely by the collective bargaining agreement. Many agreements provide for detailed safety and health protections within the contract, safety and health committees, and frequently, a grievance procedure that can be used for safety and health concerns. You may contact your union business agent regarding safety and health problems if your S&HO and supervisors have not adequately addressed safety or health concerns.

If there is no union present, then you must become aware of your rights under OSHA and other statues, and be prepared to contact those agencies directly when a problem arises.

WORKERS COMPENSATION RIGHTS

When you suffer a traumatic injury at a hazardous waste site, the workers compensation system of the state in which you are injured handles the claim. The workers compensation system will treat the injury in the same way as an injury at a construction site. However, proving the occupational nature of an illness from exposure to a hazardous substance on the work site is difficult under many workers compensation statutes. Some barriers include:

- Poor administration of the statutes.
- The statute has limitations based on the last exposure rather than when the disease was discovered.
- The degree of proof that a workplace exposure caused the illness or injury.

The requirement under the Superfund Amendments and Reauthorization Act (*SARA*) and the OSHA regulations for maintaining exposure records, as well as medical surveillance, will help employees suffering from a hazardous substance exposure to secure workers compensation. The American Federation of Labor-Congress of Industrial Organizations (*AFL-CIO*) has compiled a list of the state workers compensation laws and the various benefits and limitations from state to state. It is a good reference document in case of questions.

THIRD PARTY ACTIONS—TOXIC TORTS

Most of the injuries and illness suffered by employees on the job are compensable only by a claim for workers compensation. However, in those situations where the employer acted in a way that was calculated to bring harm to the employee, some states have permitted a personal injury recovery. The employer is generally protected against any other legal action by the employee (but not necessarily the family if they suffer from the exposure of the employee).

The manufacturer of a product that injures an employee may be sued for damages if the following conditions can be shown:

- The product was the cause of the illness or injury.
- The manufacturer did not properly warn of the harm from exposure.

It should be clearly understood that while virtually every workplace illness or injury falls under the state workers compensation laws, the difficulty of proving causation makes third party cases much less of a certainty. For example, in the case of the toxic substance exposure, proof of a relationship between employee exposure and employee illness or injury frequently involves extensive scientific study.

HEALTH AND SAFETY LIABILITY

Employer, employee, and union liabilities vary and are explained in the following sections.

Employers

The employer is responsible for ensuring the safety and health of employees on the job site. Therefore, the employer will be principally responsible for any injury or illness that results from an action taken by the employer or employees on the job site that leads to harm against others. Sometimes, the action of the employer is so reckless that courts will award damages to the employee for injury over and above the workers compensation benefits. However, cases against employers are difficult to prove as the law is extremely protective of the employer.

Employees

Generally, employees are held immune from liability to third persons, as the employee is considered to be acting on the employer's behalf in connection with activities on the job site. However, such immunity has its limits. Deliberate acts that lead to harm could result in both civil and criminal liability against the individual doing such acts.

Unions

Traditionally, the union is not held liable for actions on the workplace, because it is the employer that has the ultimate responsibility for directing an employee's activities on the job. It is important that the employer be recognized as having the final decision on job site activities, even though the union participates in safety and health committees through the collective bargaining process. To the extent that the union, or the training fund, engages in safety and health training activities, such activities must conform strictly to existing safety and health laws and regulations.

SAFETY AND HEALTH REGULATIONS AT DOE FACILITIES

The protections of the OSH Act and the OSHA standards generally apply to all employees employed by private employers. However, the OSH Act specifically does not apply to the federal or state governments and their employees.

Private Contractors Working at Federal Government Facilities

The general rule is that employees are covered by OSHA when they are employed by a private company on a contract at a government facility. Most of the time, if employees believe there is a safety violation, they or the union can call the federal OSHA office (or the state OSHA office when there is a "state plan") and ask for an inspection.

However, Sec. 4(b)(1) of the OSH Act gives some federal agencies the option to establish their own safety and health program, displacing OSHA:

> Sec. 4(b)(1) Nothing in this chapter [the OSH Act] shall apply to working conditions of employees with respect to which other Federal agencies ... exercise statutory authority to prescribe or enforce standards or regulations affecting occupational safety of health.

Under the Atomic Energy Act, 42 U.S.C. 2201(i), the Department of Energy (*DOE*) has broad authority to establish standards for the operation of nuclear research and production facilities under its jurisdiction. Using this authority, DOE has implemented its own safety and health program at its nuclear research and production sites. At these sites, it is the DOE, and not OSHA, that enforces safety and health rules applicable to contractors and workers performing environmental restoration work.

As part of its contracting process, DOE uses a standard health and safety contract clause in its management and operation contracts. This clause clearly establishes the contractor's responsibility to maintain job safety at DOE facilities, and DOE's authority to enforce its health and safety policies. The standard health and safety clause for government-owned or -leased facilities provides:

> The contractor shall take all reasonable precautions in the performance of the work under this contract to protect the safety and health of employees and of members of the public and shall comply with all applicable safety and health regulations and requirements (including reporting requirements) of DOE. The [DOE] contracting officer shall notify the contractor, in writing, of any noncompliance . . . and the corrective action to be taken. After receipt of such notice, the contractor shall immediately take corrective action. The contractor shall submit a management program and implementation plan to [DOE] within 30 days after the date of award of this contract. In the event that the contractor fails to comply with said regulations or requirements of DOE, the contracting officer may...issue an order stopping all or any part of the work[.] 48 C.F.R. 970.5204-2

Pursuant to DOE Order 5483.1A (6/22/83), contractors at government owned-contractor operated (*GOCO*) facilities must comply with the following OSHA standards:

- 29 *CFR* Part 1910 (General Industry Standards, includes hazardous waste operations standard and employee access to medical records standard.)
- 29 CFR Part 1926 (Construction)
- 29 CFR Part 1915 (Shipyards)
- 29 CFR Part 1918 (Longshoring)
- 29 CFR Part 1928 (Agriculture)

Because DOE has adopted the OSHA safety and health standards, training that employees receive on the OSHA safety and health standards generally applies to DOE facilities. Under the DOE order, contractors at a DOE facility must provide employees with reasonable access to current copies of these OSHA safety standards for review.

Instructions and Information for Employees

Although DOE has essentially adopted the substance of the major OSHA standards, its enforcement procedures are different. Order No. 5483.1A includes the following requirements for providing health and safety information to employees and for ensuring contractor compliance with job safety and health rules:

- All contractor employees shall be instructed by the contractor to:

  1. Observe the DOE-prescribed OSHA standards applicable to their work and promptly report to the contractor any condition that may lead to a violation of these standards.

  2. Report emergencies and respond to warning signals that may be activated in the event of fire, radiation, or other possible emergencies.

- DOE contractor employees shall be trained on the safety and health requirements of DOE Forms 5480.2 and 5480.3 or DOE Forms EY-632 and EY-632S, as appropriate.

- All contractor employees shall be fully informed (at least annually) by the contractor of:

  1. Their rights, protections, and obligations, which include nondiscrimination.

  2. The filing of complaints.

  3. Availability of the DOE-prescribed OSHA standards and of complaint form DOE F 5480.4 Attachment 11-1.

4. Accompaniment of the DOE inspector during the conduct of compliance inspections or during the conduct of inspections based on the filing of complaints

- Employees shall be informed that the contractor is required to monitor their workplace for radiation exposure and known toxic materials or harmful physical agents that are used or produced at the GOCO facility, and to maintain records of the data as required by 29 CFR 1910.20.
- Contractor employees or former employees shall have access to their personal safety, health, and medical records.

Compliance Inspections

DOE Order No. 5483.1A includes the following requirements for ensuring contractor compliance with job safety and health rules:

- Occupational safety and health professionals of field organizations shall conduct unannounced compliance inspections of GOCO facilities, using the DOE-prescribed OSHA standards as requirements. These inspections are in addition to occupational safety and health appraisals or audits required by any other DOE order, and shall be conducted on a priority basis with respect to the safety and health hazards involved and the number of employees affected.
- The contractor shall not be notified in advance of compliance inspections, except for situations involving contractor employee complaint allegations of imminent danger where DOE may elect to notify the contractor immediately to assure elimination of the danger and/or removal of employees from the danger...before the inspection is conducted.
- DOE inspectors shall meet with management to explain the purposes of the visit. The contractor management representative and the representative authorized by the employees shall be given an opportunity to accompany the DOE inspector during the inspection.

- When the inspection party moves from one section of the facility to another, or where the security restrictions would prevent access, a different representative authorized by the employees may accompany the inspector.

- If a situation which presents an imminent danger to contractor employees' safety and health is discovered, the inspector shall take immediate action to ensure that employees are removed from the danger area and/or that the danger is eliminated.

- Upon completion of the inspection, the DOE inspector shall hold a closeout meeting with the contractor management and, if requested, with the employees or authorized employee representatives to inform them of the inspection findings. Copies of the notice of violation(s) shall be posted conspicuously by the contractor in the general area of the violation for a period of five working days or until the violation is corrected, whichever is longer. Employees can object to the abatement period set by DOE.

In addition to the general DOE order that is applicable to all work at GOCO facilities, DOE has issued a separate Order 5489.9 (11/18/87) dealing specifically with safety on construction projects. In addition to complying with the specific provisions of the OSHA Construction Standards, 29 CFR Part 1926, DOE requires that construction contractors submit an outline prior to beginning work describing the company safety program.

The company safety program must include:

- Provisions for emergency aid by trained medical personnel, and adequate fire protection during all phases of construction.

- Programs for training, inspections, reporting, and certifying the safe operating condition of equipment, cranes, vehicles, pressure vessels, etc.

- Adequate provisions for exchanging information (e.g., meetings) on project changes, hazards, inspection deficiencies, coordination problems; this communication must include supervisors, craft representatives and other contractors on the job.

- A description of the company's past injury, accident, fire and property damage experience.

- The name and qualifications of the job site management official responsible for administering the safety program.

Summary

In summary, DOE's policies regarding safety and health at the defense nuclear facilities are similar in most respects to your OSHA rights working at private facilities. However, it is important that you and your union be familiar with DOE's procedures for addressing health and safety problems.

DOE Contractor Employee Protection Program

In March, 1992 the DOE adopted strong regulations protecting employees of DOE contractors who report problems with job site safety and health, fraud, mismanagement, or other problems. These protections were part of a formal regulation, the "DOE Contractor Employee Protection Program," 10 CFR Part 706. The DOE policy also reinforces an employee's right to refuse unreasonably dangerous work.

Employee Rights Under DOE Program

Below are the key portions of the regulation that outline an employee's basic rights under the program. Note particularly that if employees feel they have been discriminated against, they or their union representative must notify the contractor, DOE, or a member of Congress within 30 days of the event. Providing notice to the union alone will not be sufficient to protect an employee's rights, if the union is unable to file a protest with the employer or DOE within the allotted time.

10 CFR §708.3 Policy

It is the policy of DOE that employees of contractors at DOE facilities should be able to provide information to DOE, to Congress, or to their contractors concerning violations of law, danger to health and safety, or matters involving mismanagement, gross waste of funds, or abuse of authority, to

participate in proceedings conducted before Congress or pursuant to this part, and to refuse to engage in illegal or dangerous activities without fear of reprisal. Contractor employees who believe they have been subject to such reprisal may submit their complaints to DOE for review and appropriate administrative remedy as provided...in this part.

10 CFR §708.4 Definitions

...Discrimination or discriminatory acts mean(s) discharge, coercion, restraint, threats, intimidation, or other similar negative action taken against a contractor employee by a contractor, as a result of the employee's disclosure of information, participation in proceedings, or refusal to engage in illegal or dangerous activities, as set forth in §708.5(a) of this part.

10 CFR §708.5 Prohibition Against Reprisals

(a) A DOE contractor covered by this part may not discharge or in any manner demote, reduce in pay, coerce, restrain, threaten, intimidate, or otherwise discriminate against any employee because the employee (or any person acting pursuant to a request of the employee) has --

(1) Disclosed to an official of DOE, to a member of Congress, or to the contractor (including any higher tier contractor), information that the employee in good faith believes evidences —

(i) A violation of any law, rule, or regulation;

(ii) A substantial and specific danger to employees or public health or safety; or

(iii) Fraud, mismanagement, gross waste of funds, or abuse of authority;

(2) Participated in a Congressional proceeding or in a proceeding conducted pursuant to this part; or

(3) Refused to participate in an activity, policy or practice when—

(i) Such participation—

(A) Constitutes a violation of a Federal health or safety law; or

(B) Causes the employee to have a serious reasonable apprehension of serious injury to the employee, other employees, or the public due to such participation, and the activity, policy, or practice causing the employee's apprehension of such injury—

(1) Is of such a nature that a reasonable person, under circumstances then confronting the employee, would conclude there is a bona fide danger of an accident, injury, or serious impairment of health or safety resulting from participation in the activity, policy or practice; and

(2) The employee is not required to participate in such dangerous activity, policy or practice because of the nature of his or her employment responsibilities;

(ii) The employee, before refusing to participate in the activity, policy or practice has sought from the contractor and has been unable to obtain a correction of the violation or dangerous activity, policy or practice; and

(iii) The employee, within 30 days following such refusal, discloses to an official of DOE, a member of Congress, or the contractor, information regarding the violation or dangerous activity, policy or practice, and explaining why he has refused to participate in the activity.

(b) An employee disclosure, participation, or refusal described in §708.5(a)(1), (2), or (3) shall be subject to this part only if it relates to activities alleged to have occurred under work performed by the contractor for DOE. This part is not intended to override any other provision or requirement of any regulation pertaining to Restricted Data, national security information, or any other classified or sensitive information[.]

10 C.F.R. 708.13 Communication of Program to Contractor Employees.

(a) All contractors covered by this part shall inform their employees of the applicability of the DOE Contractor Employee Protection Program, including identification of the DOE offices to which a protected disclosure can be made and identification of appropriate points of contact for initiating employment-reprisal complaints.

(b) The information required in paragraph (a) of this section shall be prominently posted in conspicuous places at the contractor work site, in all places where notices are customarily posted[.]

Whistleblower Protection

The DOE's program prohibiting retaliation against employees who report problems at DOE facilities, or who refuse to perform unreasonably hazardous work, provides employees with important protections. It is important for employees to know their rights, and exercise them.

SAFETY AND HEALTH PROTECTIONS FOR GOVERNMENT EMPLOYEES

Government employees are exposed to the full range of hazards that face private industry employees. For example, government employees:

- Work in hospitals and schools.
- Are responsible for public safety and maintaining public works.
- Inspect mines, food plants, construction projects, and factories.

Government agencies employ a large portion of the American work force, and there is an obvious need to provide effective safety and health programs for their protection. However, government employees often have much less protection than employees in the private sector because OSHA standards do not directly apply to them.

Although the protections of the OSH Act and the OSHA standards apply generally to "employees" of "employers," government employees are specifically excluded from coverage. Under the section "Definitions," the term employer means a person engaged in a business affecting commerce who has employees. It does not include the United States or any state or political subdivision of a state. In short, the OSH Act and the OSHA health and safety standards directly protect only private-sector workers. Federal and state government employees are not covered directly by federal OSHA standards.

Why are government employees not covered directly by OSHA? When Congress originally enacted the OSH Act, it wanted to avoid a situation where one federal agency, DOL, would be policing other agencies of government. Unfortunately, this means that the standards and enforcement procedures available for private-sector employees under the OSH Act generally are not available to government employees.

SAFETY AND HEALTH PROTECTIONS FOR FEDERAL EMPLOYEES

Section 18 of the OSH Act specifically addresses the need for federal employee health and safety protections. Figure 10-1 summarizes the directives regarding safety and health regulations for federal employees. Basically, the law simply provides that each federal agency is responsible for adopting a safety and health program for its own employees. The programs must provide protections equal to the OSHA standards.

Section 18 of the OSH Act

Section 18 of the OSH Act provides that:

(a) It shall be the responsibility of the head of each Federal agency to establish and maintain an effective and comprehensive occupational safety and health program which is consistent with [the OSHA standards]. The head of each agency shall (after consultation with representatives of the employees thereof)—

(1) provide safe and healthful places and conditions of employment...;

(2) acquire, maintain, and require the use of safety equipment, personal protective equipment, and devices reasonably necessary to protect employees;

(3) keep adequate records of all occupational accidents and illness for proper evaluation and necessary corrective action;

Regulation	Description
Section 18 of the OSH Act	Requires federal agencies to adopt comprehensive safety and health programs consistent with OSHA standards.
Executive Order 12196	Directs federal agencies to implement safety and health programs, per Section 18, and establishes additional guidelines for agency programs.
OSHA Regulation 29 CFR 1960	Sets detailed minimum standards for agency safety and health programs, as determined by the Department of Labor.
Agency Guidelines or Orders	Establish safety and health standards for agency personnel, as well as enforcement mechanisms, consistent with Section 18, E.O. 12196, and OSHA regulation 29 C.F.R 1960.

Figure 10-1. This figure summarizes the health and safety regulations for federal employees.

(4) consult with the Secretary [of Labor] with regard to the adequacy ... of records; and

(5) make an annual report to the Secretary [of Labor] with respect to occupational accidents and injuries and the agency's [safety and health program].

Executive Order 12196

Executive Order 12196, "Occupational Safety and Health Programs for Federal Employees," was issued to implement the mandate of Section 18 of the OSH Act. The Executive Order applies throughout the federal government, except for military personnel and uniquely military operations.

The Executive Order directs federal agency heads to provide health and safety protections similar to the OSHA rights enjoyed by private sector employees. It also directs the Secretary of Labor to provide leadership to these agencies in developing their safety and health programs. Under the Executive Order:

- Federal employees are entitled to the full protection of all the published OSHA standards, unless the Secretary of Labor has approved an alternative safety procedure.

- Just as private-sector employees are protected against discrimination under Section 11(c) of the OSH Act, the head of each federal agency also must establish procedures to protect federal employees who report safety violations from subsequent discrimination or reprisal.

- Federal agencies must create a system under which federal employees can report safety and health violations while keeping their identities confidential.

- Reports of imminently dangerous conditions by federal employees must be investigated within 24 hours, serious conditions must be investigated within 3 working days, and other complaints within 20 working days.

- A representative of federal employees must be allowed to accompany the safety and health inspector.

The Executive Order authorizes federal agencies to:

- Establish joint labor and management safety committees at the national and field operations level.
- Monitor the agency's performance in implementing the safety and health program.

Although each federal agency retains primary responsibility for investigating complaints of safety violations at its work sites, the Executive Order provides that the Secretary of Labor may inspect federal government work sites when an agency fails to respond adequately to a complaint.

DOL Guidelines for Federal Agency Safety and Health Plans, 29 CFR 1960

The DOL has issued lengthy regulations to implement the Executive Order. These regulations for the Federal Employee Occupational Safety and Health program (*FEOSH*), detailing the requirements imposed on each federal agency, are published in 29 CFR 1960. Major elements of the regulations are summarized below.

Funding the Safety Program

Each federal agency must designate an official who will be responsible for the safety and health program. In addition, the head of the agency is required to include in the agency budget sufficient funds to operate the occupational safety and health program, including funds needed for:

- Safety and health personnel, including administrative costs, training, personal protective equipment, etc.
- Abatement of safety and health hazards.
- Sampling and diagnostic tools, laboratory analyses.
- Outside contracts to evaluate unhealthy conditions, if necessary.
- Promotional brochures, posters, films, etc.
- Technical resources such as books and periodicals.
- Medical surveillance programs for employees.

Providing Program Information to Employees

The regulation requires that the details of the agency's health and safety program must be made available to employees on request. In addition, each agency must develop and post in all workplaces the agency's version of the "OSHA poster," advising employees of:

- Agency procedures for reporting safety and health violations.
- The location where employees can get more information about the agency's safety program.
- Relevant information about any safety and health committees.

Reports of Safety Violations

Under DOL rules, any federal employee who believes that an unsafe or unhealthful working condition exists must have the right "and is encouraged" to report the condition to the appropriate agency official and ask for an inspection. With regard to employee confidentiality,

> "Upon the request of the individual making such report, no person shall disclose the name of the individual making the report of the names of individual employees referred to in the report, to anyone other than authorized representatives of the Secretary [of Labor]."

Agencies are required to keep a log of all reports of safety and health violations. These logs must be kept at each agency establishment. They must also investigate reports of unsafe conditions, and, where appropriate, issue a "Notice of an Unsafe or Unhealthful Working Condition." Abatement actions should be started promptly.

Under limited circumstances, OSHA itself is authorized to conduct safety and health inspections. These inspections may occur if:

- There is no functioning joint safety and health committee.
- Half the membership of the safety and health committee asks OSHA to conduct an investigation.

- An employee has reported an imminent danger, and OSHA determines that neither the agency nor the safety and health committee has responded to the employee's report.

Training

As part of the FEOSH program, federal agencies are required to provide extensive training to their work force. Top management of the agency must be given an orientation concerning the agency's enforcement responsibilities. Supervisors must be trained in their "line" responsibilities to ensure compliance with safety and health regulations. Training must be provided for the agency's safety and health specialists, and inspectors.

Finally, both employees and union representatives must be provided with training in safety and health concerns specifically related to the jobs they perform.

Recordkeeping and Reporting

Like private employers, federal agencies must keep records of safety and health incidents.

- Federal agencies must keep a log of all occupational injuries and illnesses, similar to the OSHA Form 200.
- Serious accidents resulting in fatalities or injuries to several persons must be reported to OSHA within 48 hours after their occurrence.
- Annually, each federal agency establishment must post a summary of the occupational injuries and illnesses.

Requesting a NIOSH Investigation

As in private sector situations, the expertise of NIOSH is available to help federal agencies find solutions to possible health hazards. However, there are some restrictions on who can request a NIOSH study. Requests for NIOSH investigations of problems facing federal employees can be made by:

- OSHA
- The federal agency head
- The joint safety and health committee, if half the members request such an investigation
- The individual employees (at facilities that have no safety and health committees)

DOE Federal Employee Occupational Safety and Health Program

Consistent with DOL regulations, the Secretary of the DOE has published an Order detailing DOE's FEOSH Program. The Department policy is published as DOE Order 3790.1B.

The policies for federal employees at DOE facilities should not be confused with policies for DOE contractor employees at the same sites. These are covered under a separate series of department orders, and generally are included in DOE procurement contracts. The policies applicable to contractor personnel are covered elsewhere in this course material.

Federal employees are entitled to a copy of the DOE order on request, and are encouraged to obtain a copy for their own reference.

SAFETY AND HEALTH PROTECTIONS FOR STATE AND LOCAL GOVERNMENT EMPLOYEES

In many respects, health and safety protections for state and local government employees have lagged behind protections for private and federal employees. As noted above, the OSH Act itself, and the OSHA standards, apply only to private sector workers. Federal employees are entitled to receive comparable protections, pursuant to the OSH Act, Presidential Executive Order 12196, Labor Department regulations, and agency regulations and orders.

Unfortunately, the protections for state employees often are much weaker. Generally, states can be divided into three categories in terms of protection levels provided to state and local government employees. They are states that have:

- Comprehensive state OSHA plans
- Limited state OSHA plans
- No state OSHA plans

States with Comprehensive State OSHA Plans

Under DOL regulations, any state that chooses to have a comprehensive state OSHA plan for private sector employers must also provide the same level of protection for state government employees. This situation applies to about half the states. Under this policy, therefore, protections for state government employees in the "state OSHA" states are the same as for private sector employees, and at least as protective as federal OSHA standards. In most of these states, the state OSHA protections will extend to local government employees as well.

States with Limited State OSHA Plans

Two states that do not have state OSHA plans are New York and Connecticut. These states have chosen to adopt a full set of safety and health standards applicable to state and local government employees. The state standards for government employees have been approved by federal OSHA as being the equivalent of federal OSHA standards. In Connecticut and New York, state and local government employees can contact state government agencies for enforcement of standards, even though private sector employees would contact federal OSHA for enforcement of OSHA standards.

States without State OSHA Plans

At the present time, the remaining states have no consistent policy for protecting government employees. In many situations, there are simply no health and safety protections for state and local government employees at all, while in other cases there may be a variety of different policies. Health and safety protections for government employees in the states that have not adopted their own comprehensive "state OSHA plans" must be reviewed on a case-by-case basis.

SECTION 10 - ASSIGNMENT SHEET

1. List 14 employee rights under the Occupational Safety and Health Act of 1970.

2. List the OSHA standards that contractors at Government-Owned Contractor-Operated (GOCO) facilities must comply with pursuant to DOE Order 5483.1A (6/22/83).

3. List the requirements for providing health and safety information to employees, and for ensuring contractor compliance with job safety and health rules under DOE Order No. 5483.1A.

4. List the minimum health and safety regulations for federal employees.

GLOSSARY

HAZARDOUS WASTE WORKER REFRESHER

A

Access control point - Exit and entry points at the boundary of the exclusion zone where the flow of equipment and personnel are regulated into and out of the exclusion zone.

Accident - An undesirable, unplanned event resulting in personal physical harm, damage to property, or interruption of business.

ACGIH - American Conference of Governmental Industrial Hygienists

Acute effect - A health effect that is seen quickly, usually after an exposure to a high concentration of a hazardous material.

Acute exposure - A single short exposure, or a few short exposures, usually to a relatively large concentration of a chemical or energy source, such as noise, radiation, or heat.

Administrative controls - Exposure control measures that reduce exposure to an acceptable limit by scheduling reduced work times in contaminated areas and establishing work rules.

AFL - American Federation of Labor

AFL-CIO - American Federation of Labor-Congress of Industrial Organizations

AHERA - Asbestos Hazard Emergency Response Act

ANSI - American National Standards Institute

APR - Air purifying respirator

ASME - American Society of Mechanical Engineers

Asphyxiant - A substance that can cause oxygen deficiency in the blood and can lead to loss of consciousness, serious injury, or death. There are two types of asphyxiants—simple and chemical.

ATSDR - Agency for Toxic Substances and Disease Registry

Attendant - A worker who remains outside the confined space while work is being done inside.

B

BAC - Breath alcohol concentration

Base - A substance which turns litmus blue, produces hydroxyl ions in water solutions, and reacts with acids to form water and salts.

Bioassy - Process of evaluating body samples (e.g., nails, hair, urine) to determine the presence of chemicals or radiation in the body.

Blanking (or blinding) - The absolute closure of a pipe, line, or duct by the fastening of a solid plate that completely covers the bore and is capable of withstanding the maximum pressure of the pipe, line, or duct.

Blinding - (see Blanking)

Breakthrough - The point at which chemicals begin to pass through a respirator filter because the filter's saturation point has been reached.

Bridging - A condition that occurs when grain, or a similar loose material, clings to the sides of a container or vessel that is being emptied from below. A hollow space is created with an unstable covering of grain over it.

Bulking - The process of mixing identified wastes and packing them in bulk containers (e.g., tank trailers or vacuum truck) for shipping to treatment or disposal facilities.

C

C - Ceiling limit

C° - Celsius or centigrade

Calibration gas - A reference gas used to adjust the settings on an air monitoring instrument to known measurements.

Carcinogens - Substances that cause cancer.

Caustic - Alkali that strongly irritates, burns, corrodes, or destroys living tissue.

Ceiling limit - Exposure level for a substance that should never be exceeded.

CCA - Chromated copper arsenate

CERCLA - Comprehensive Environmental Response Compensation and Liability Act (commonly known as Superfund)

CFR - Code of Federal Regulations

CGI - Combustible gas indicator

CG/OI - Combustible gas and oxygen indicator

Chain of custody - Process that documents each person who handles a groundwater sample from the time of collection to laboratory analysis.

Characterization - The process in which material sampling is used to identify the chemical composition of unknown or potentially hazardous materials.

Chemical reaction - A chemical change that occurs when chemicals combine with each other to produce a new substance and release of energy.

Chronic effect - A delayed health effect that is usually the result of repeated exposure to low doses of a substance over a long period of time.

Chronic exposure - A repeated exposure that occurs over months and years, usually at relatively low concentrations of a chemical.

Combustible material - Any material with a flash point between 100°F and 200°F.

Compatible - Chemicals that can exist in close and permanent association with each other without creating a hazard.

Confined space - Any area with the following characteristics: adequate size and shape to allow a person to enter; limited opening for workers to enter and exit; and not designed for continuous human occupancy.

Confined space permit - An authorization form that is the primary source of information for hazards found in a permit-required confined space and their controls.

Consent decree - A legal document that specifies your obligations when you enter into a settlement with the government.

Contaminant - Substance unintentionally introduced into air, water, or food products which has the effect of rendering them toxic or otherwise harmful.

Contaminant reentrainment - When external contaminants are drawn into a confined space during the process of ventilation by placing a fresh air intake too close to a source of contamination.

Contamination reduction corridor - Designated area within the contamination reduction zone that provides passage for workers and equipment from the support zone to the exclusion zone. It is the area where decontamination procedures take place.

Contamination reduction zone - The zone, located between the exclusion zone and the support zone, that provides a transition between the contaminated and clean areas.

Controlled access zone - An area in which certain work may take place without the use of guardrail systems, personal fall arrest systems, or safety net systems. Entry to the zone is controlled.

Corrosive chemical - Any solid, liquid, or gaseous substance that attacks building materials or metals or that burns, irritates, or destructively attacks organic tissue, most notably the skin and when taken internally the lungs and stomach.

CPC - Chemical protective clothing

CPE - Chlorinated polyethylene

CPR - Cardiopulmonary resuscitation

CRC - Contamination reduction corridor

CRZ - Contamination reduction zone

CTD - Cumulative trauma disorders

CWA - Clean Water Act

D

dB - Decibels

Decontamination - Process of removing or neutralizing chemicals that have accumulated on PPE, tools, or equipment used on the job.

Degradation - The process by which a chemical changes a protective material so that the protective material loses some of its effectiveness as a barrier.

Dermatitis - Skin irritation with symptoms such as red, itchy skin, swelling, ulcers, and blisters.

DHHS - Department of Health and Human Services

DOD - Department of Defense

DOE - Department of Energy

Doffing - The act of removing PPE.

DOL - Department of Labor

Donning - The act of putting on PPE.

DOP - Dioctyl phthalate

Dose - The amount or concentration of a substance a person receives over a specific period of time.

DOT - Department of Transportation

Double block and bleed - A system of closing off a pipe using a T-configuration. Two valves block off materials and one valve bleeds the pipe. It is used to isolate a confined space.

Double purge - The process of ventilating a confined space with breathable air after it has been inerted.

DRI - Direct reading instruments

DWI - Driving while intoxicated

E

EAP - Employee Assistance Program

ECG or EKG - Electrocardiogram

Energy-isolating device - A mechanism that prevents the release of energy or materials.

Engineering controls - Exposure control measure that reduces or eliminates exposures by using mechanical means, such as ventilation systems, acoustical material, and clean air control booths. This measure does not eliminate the hazard.

Ensemble - The term used for a whole outfit of protective equipment, usually a specific pairing of a respirator with a type of protective clothing.

Entrant - A worker who enters the confined space to work.

Entry supervisor - The person (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by the regulations.

EPA - Environmental Protection Agency

ESLI - End of service life indicator

Exclusion zone - The area where hazardous waste clean-up work takes place and contamination occurs.

Exhaust system - A system, that pulls air from a confined space using fans or fume hoods.

F

FEOSH - Federal Employee Occupational Safety and Health

FID - Flame ionization detector

First-break - The initial disconnection or breaking of the pipeline.

Flame ionization detector - A portable instrument used to detect organic compounds.

Flammable atmosphere - An atmosphere resulting from vaporization of flammable liquids, by-products of chemical reaction, or concentrations of combustible dusts.

Flammable material - Any material with a flash point below 100°F.

Flammable range - The concentrations between the lower flammability limit and the upper flammability limit.

Flash point - The lowest temperature at which a material gives off enough vapors to form an ignitable mixture with the air.

FM - Factory Mutual

G

Gastrointestinal tract - The stomach and intestines

GC - Gas chromatograph

GC/MS - Gas chromatography-mass spectrometry

General ventilation - The process of ventilating the entire confined space.

GOCO – Government owned/contractor operated

H

Hazard - Any condition, situation, or agent that has the potential to produce an undesirable effect.

Hazardous atmosphere - An atmosphere which contains one or more of the following hazards: oxygen deficiency/oxygen enrichment, flammable atmosphere, or toxic air contaminants.

Hazardous substances - Any substances or materials that in normal use (e.g. processing plant work, manufacturing, and chemical decontamination on hazardous work sites) can be damaging to the health and well-being of workers or the environment.

Hazardous Substance Superfund- A trust fund that provides operating money for government-financed actions under CERCLA.

Hazardous waste - A hazardous substance that has been discarded or otherwise designated as a waste material.

HazMat - Hazardous Materials

HEPA filter - High efficiency particulate air filter

High efficiency particulate air filter - A filter capable of capturing 99.97% of the particles pulled through it.

HMIS - Hazardous materials identification system

Hot line - Outer boundary of the exclusion zone.

Hot zone - Common name for the exclusion zone.

HRS - Hazard Ranking System

HSIF - Hazardous substance information form

HSWA - Hazardous and solid waste amendments.

I

IAA - Isoamyl acetate

ICAO - International Civil Aviation Organization

IDLH - Immediately dangerous to life and health

IH - Industrial Hygienist

Immediately dangerous to life or health - An exposure level in an environment likely to cause death or serious health effects with very short exposures.

Incompatible - Chemicals that react together and result in a hazard.

Inerting - Removal of oxygen from a confined space by introducing a nonreactive gas to reduce the flammable mixture of fuel and oxygen so ignition or combustion is not possible.

Ingestion - 1.The act of taking food and other substances into the body by the mouth. 2. A route of entry into the body along with food or water, or through inhalation and then swallowing.

Inhalation - 1. The act of breathing in a substance in the form of a gas, vapor, fume, mist, or dust. 2. A route of entry into the body for microorganisms, chemicals, or physical agents during breathing.

Interaction - A condition that occurs when exposure to more than one substance results in a health effect different from the effects of either one alone. There are two types of interaction: synergism and potentiation.

Isolation - The process by which a space is removed from service and completely protected against the release of energy and material into the space.

J

No entries

K

kg - kilogram

L

Laboratory pack - Drum containing individual containers of laboratory materials normally surrounded by cushioning and absorbent material. Also called a lab pack.

Latency period - The time period between the first exposure and the appearance of disease caused by the exposure.

LEL - Lower explosion limit

LFL - Lower flammability limit

Line breaking - The term used for the intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic materials; inert gases; or any fluids at a volume, pressure, or temperature that is capable of causing injury.

LIUNA - Laborers' International Union of North America

Local effect - The health effect that occurs at the location where a chemical comes in contact with the body.

Local exhaust - The process of removing contaminants at their source.

M

Macrophage - A large white blood cell that ingests microorganisms or other cells and foreign particles that enter the body.

MAP - Membership Assistance Program

Material safety data sheet - The primary source of information for hazardous chemicals used on a hazardous waste work site.

Maximum use concentration - The highest concentration of a specific contaminant for which a cartridge or canister provides approved protection.

Maximum use level - The level of a specific contaminant that, if exceeded, will cause a worker to be exposed above the PEL because of leakage in a respirator.

Mechanical ventilation - The use of blowers or fans and ducts to ventilate a confined space.

Metabolites - By-products (what is left behind) of drugs as they pass through the body.

mg/m³ - milligrams per cubic meter

MRO - Medical review officer

MSA - Mine Safety Appliance

MSDS - Material safety data sheet

MSHA - Mine Safety and Health Administration

MUC - Maximum use concentration

MUL - Maximum use level

Mutagenic effect - A permanent mutation or change to the genes and chromosomes in the female ovum or male sperm. A mutagenic effect can cause birth defects.

N

NESHAP - National Emission Standards for Hazardous Air Pollutants

NFPA - National Fire Protection Association

ng - nanograms

NIDA - National Institute for Drug Abuse

NIOSH - National Institute of Occupational Safety and Health

NLRB - National Labor Relations Board

NRC - 1. Nuclear Regulatory Commission
2. National Response Center

NRR - Noise reduction rating

O

Occurrence - Any event or accident that is a deviation from planned or expected behavior or events, such as an injury or death, involvement with nuclear explosives, accidental release of pollutants, or accidental release of radioactive material above regulatory limit.

Olfactory fatigue - Condition that occurs when the sense of smell is dulled from a chemical exposure.

On-scene coordinator - Under the NCP, a representative of EPA or the state who directs or coordinates operations at the scene of a removal action.

Operable unit - Separate response measures, consistent with a permanent remedy, but not the entire permanent remedy itself.

Operation and maintenance - Activities conducted at a site after a Superfund site remedial action is completed to ensure that the remedy is effective and operating properly.

Organic compound - A chemical compound containing carbon.

OSHA - Occupational Safety and Health Administration

OSH Act - Occupational Safety and Health Act

OVA - Organic vapor analyzer.

Over breathing - When, under heavy work conditions, a worker uses more air than a PAPR can provide, creating negative pressure in the mask.

Oxidizing material - Material that initiates or supports combustion in another material, causing fire either by itself or through the release of oxygen or other gases.

Oxygen-deficient atmosphere - As defined by OSHA, an atmosphere that contains less than 19.5 percent oxygen by volume. This atmosphere cannot support life.

Oxygen displacement - Condition that occurs when a gas is introduced into an area, such as a confined space, and it pushes the oxygen out to make room for itself.

Oxygen-enriched atmosphere - As defined by OSHA, an atmosphere that contains more than 23.5 percent oxygen by volume. This atmosphere is a serious fire hazard.

P

PAPR - Powered air purifying respirator

PCB - Polychlorinated biphenyl

PDS - Personnel decontamination station

PEL - Permissible exposure limit

Penetration - The process of a chemical passing through a garment by way of openings in the material, such as zippers and seams.

Permeation - The process by which a chemical moves through protective clothing on a molecular level.

Permissible exposure limit - Exposure guidelines for airborne concentrations of regulated substances that set limits upon a worker's inhalation exposure (the amount of substance a worker can safely breath).

Permit-required confined space - A confined space that contains or has the potential to contain a hazardous atmosphere, contains a material that has the potential for engulfing the entrant, has an internal configuration which could trap or asphyxiate an entrant by inwardly converging walls or by a floor which slopes downward to a smaller cross-section, or contains any other recognized serious hazard.

Personal protective equipment - Any protective clothing or device used to prevent contact with and exposure to chemical and nonchemical hazards in the work place.

PF - Protection factor

PFT - Pulmonary function test

pH - potential of hydrogen

Photoionization detector - A portable instrument used to detect many organic and a few inorganic compounds.

pH scale - A scale, from 0-14, that shows a chemical's corrosive strength.

PID - Photoionization detector

ppb - parts per billion

PPE - Personal protective equipment

ppm - parts per million

Poor warning properties - Absence of odor, taste, or other trait which warns about a chemical's presence.

Potentiation - A type of chemical reaction in which an effect of one substance is increased by exposure to a second substance that would not cause the effect by itself.

Pre-entry atmospheric testing - Testing performed from the outside of a confined space to identify hazardous conditions within the confined space.

Protection factor - The rating assigned to a respirator or class of respirators that represents the level of protection it provides.

psi - pounds per square inch

psig - pounds per square inch gauge

PTA - Parent Teacher Association

Pulmonary edema - Fluid build up in the lungs that causes shortness of breath and, if severe enough, death.

Purging - The process of replacing or diluting flammable vapors in a confined space by introducing air, steam, or water.

PVA - Polyvinyl alcohol

PVC - Polyvinyl chloride

Pyrophoric - A chemical that will ignite spontaneously in air at a temperature of 130°F or below.

Q

QLFT - Qualitative fit test

QNFT - Quantitative fit test

Qualitative fit test - A test that determines respirator fit and involves introducing a harmless, odorous, or irritating substance into the breathing zone of the wearer.

Quality Assurance/Quality Control - A system of procedures, checks, audits, and corrective actions to ensure that all research design and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality.

Quantitative fit test - A sophisticated type of fit test that measures the actual amount of leakage into the respirator.

R

Radiation - Energy emitted from radioactive materials in the form of particles or waves.1-20

RCRA - Resource Conservation and Recovery Act

REL - Recommended exposure level (NIOSH).

S

Safety - The state of being secure from hurt, injury, or loss.

SAR - supplied air respirator

SARA - Superfund Amendments and Reauthorization Act

SCBA - Self-contained breathing apparatus

Sensitizer - A chemical that can cause an allergic response in the body.

S&HO - Safety and Health Officer

Shock sensitive chemicals - chemicals that may explode if subjected to friction, heat, or shock

Short term exposure limit - Maximum concentration level of a substance to which workers can be exposed for a short period of time (usually 10 to 15 minutes) without suffering from adverse health effects.

Simple asphyxiating atmosphere - An atmosphere that contains a gas or gases, which are nonreactive and nontoxic. In sufficient quantities, the gas(es) displace the oxygen and make the atmosphere unfit for respiration.

Site safety and health plan - A site-specific plan that establishes the policies and procedures necessary to protect workers and the public from possible hazards at the site.

SLM - Sound level meter

SOP - Standard operating procedure

Sorbent - Granular material in a respirator cartridge or canister that absorbs specific contaminants from the air as the air is inhaled.

STAA - Surface Transportation Assistance Act

Standard operating procedure - Required procedures for performing the variety of work associated with activities at a hazardous waste site.

STEL - Short-term exposure limit

Substitution - Exposure control measure that eliminates a hazardous chemical by replacing it with a nonhazardous or less hazardous chemical that works as well. This control measure is the most desirable.

Supply system - A system that supplies fresh air by pushing air into a space using blowers or natural air movement.

Support zone - Outermost part of a hazardous waste site which is considered clean (uncontaminated).

SWDA - Solid Waste Disposal Act (RCRA predecessor)

SWMU - Solid Waste Management Unit

Synergism - A chemical reaction in which two chemicals produce an effect that is greater than both of their effects put together.

Systemic effect - A health effect that occurs in the body at some place other than the point of contact.

T

Target organs - An organ or system affected by a chemical.

TC - Tested and certified

Teratogenic effect - Damage to the developing embryo of a pregnant woman from her direct exposure to a chemical. Teratogenic effects can result in birth defects.

Time weighted average - Average concentration of a substance in an area over an 8-hour work shift of a 40-hour work week.

TLV - Threshold limit values

Topography - Physical features of a place or region, such as mountains, valley, stream.

Toxic chemical - A substance that has poisonous or deadly effects on the body when it's inhaled, ingested, absorbed, or comes in contact with the skin.

TSCA - Toxic Substances Control Act

TWA - Time weighted average

U

UEL - Upper explosion limit

UFL - Upper flammability limit

UHF - Ultra high frequency

UHWM - Uniform Hazardous Waste Manifest

UL - Underwriters Laboratories

UV - Ultraviolet

V

Vapor - Gases formed from liquids at normal temperatures.

Vapor density - The weight of a vapor or gas compared to the weight of an equal volume of air.

Vapor pressure - The property of a material that determines whether it is a solid, liquid, or gas at normal temperatures and pressure.

Ventilation - The continuous movement of fresh, uncontaminated air throughout a confined space to eliminate or reduce atmospheric hazards.

VHF - Very high frequency

W

Water reactive material - A material that is incompatible with water.

Wipe test - Test used to determine the amount of chemical contamination present on a surface, by drawing a sterile piece of gauze or filter paper across a surface.

Workplace monitoring - The process of collecting, detecting, and measuring the workplace for chemical, physical, and biological hazards.

Work plan - The plan that explains the actual clean-up process on a hazardous waste site

X, Y, Z

No entries

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